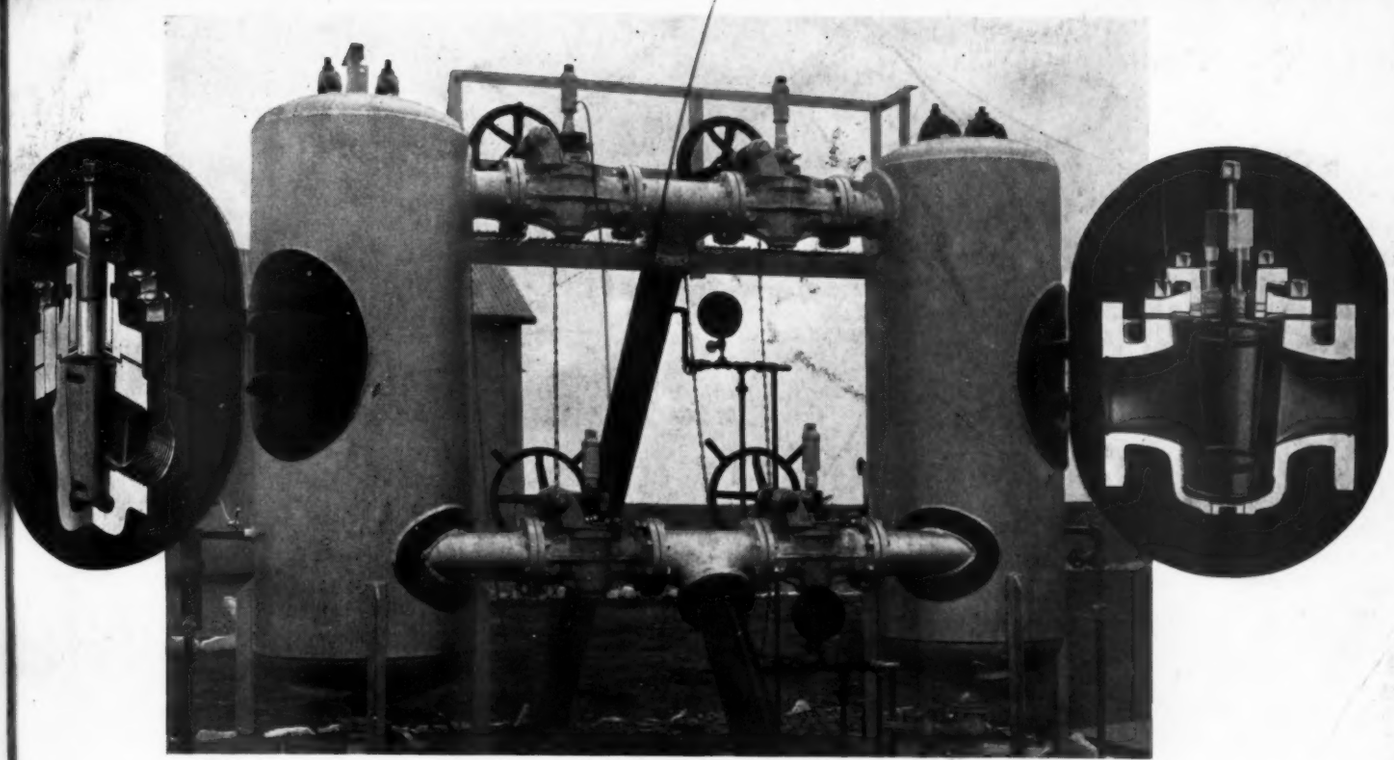


Nordstrom 6" geared lubricated plug valves on gas scrubber in Oklahoma City

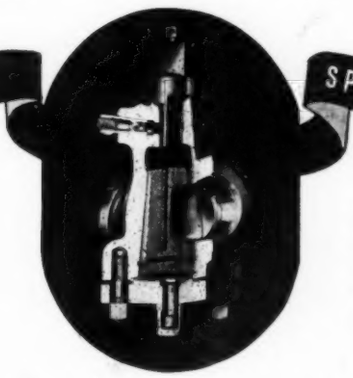
NORDSTROM VALVES

ARE PART OF THE PICTURE IN

ANY *MODERN* VALVE INSTALLATION

"EALDPORT"

LUBRICATION



SPECIAL ALLOYS FOR

SPECIAL SERVICES

MERCO NORDSTROM VALVE CO.

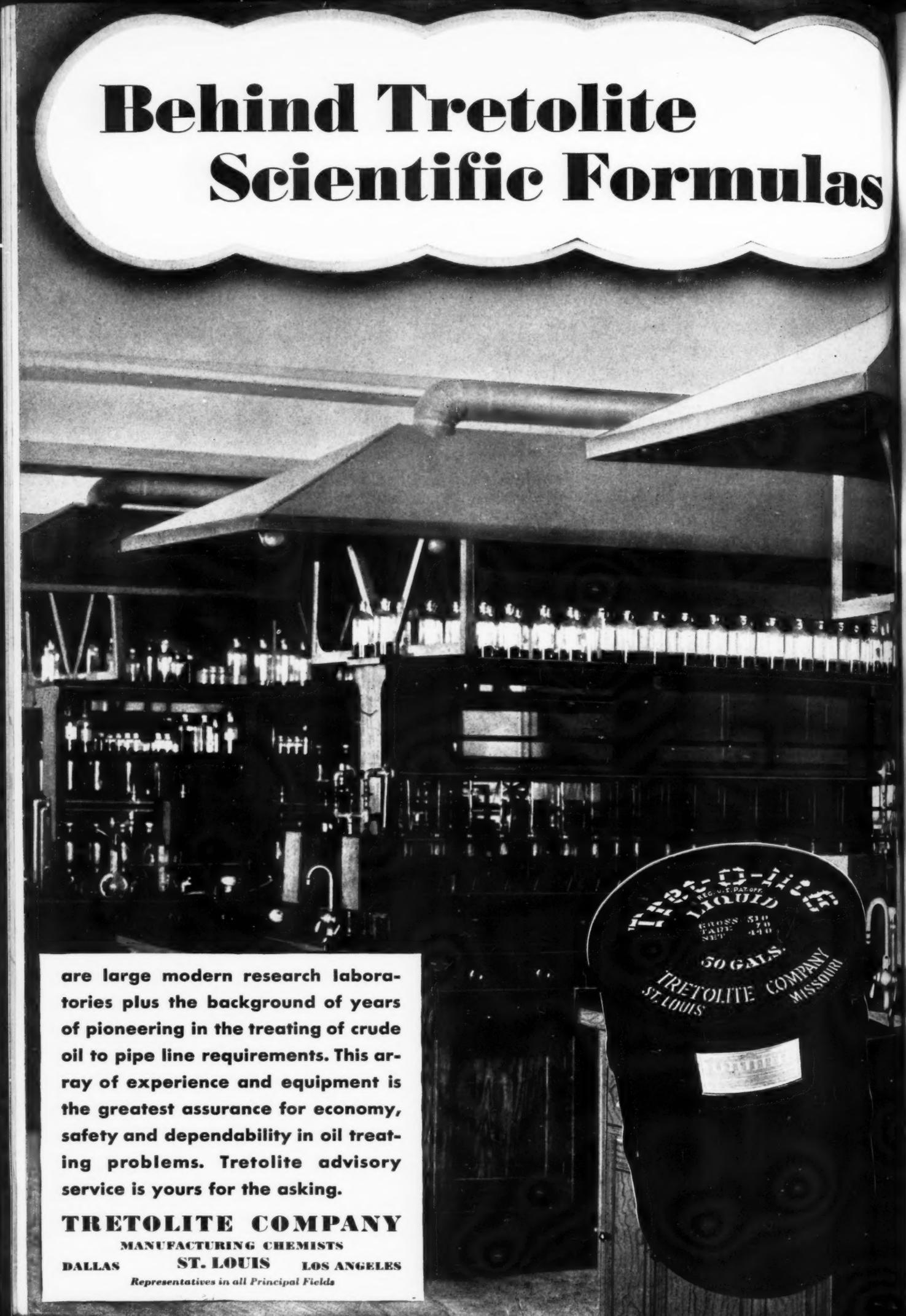
A subsidiary of

PITTSBURGH EQUITABLE METER CO.

Main Offices: Pittsburgh, Pa.

Branch Offices: New York City, Buffalo, Philadelphia, Columbia, Memphis, Atlanta, Chicago, Kansas City, Tulsa, Houston, Los Angeles, Oakland. Canadian Representatives and Licensees: Peacock Brothers, Ltd., University Tower Building, Montreal, Quebec.

Behind Tretolite Scientific Formulas



are large modern research laboratories plus the background of years of pioneering in the treating of crude oil to pipe line requirements. This array of experience and equipment is the greatest assurance for economy, safety and dependability in oil treating problems. Tretolite advisory service is yours for the asking.

TRETOLITE COMPANY

MANUFACTURING CHEMISTS

DALLAS ST. LOUIS LOS ANGELES

Representatives in all Principal Fields

The Petroleum Engineer

DECEMBER 1936

VOLUME VIII

NUMBER 3

A MAGAZINE OF METHODS FOR OPERATING MEN

This Issue Contains

DRILLING AND PRODUCTION

	Page
Power Consumption of Electric Dehydrators in California Oil Fields	27
Development Methods in the Dickinson Field — By Jos. A. Kornfeld	28
Conserving the Gravity and Volume of Crude Oil in the Field — By S. F. Mauney, Jr.	33
Computing Cost of Dehydrating Crude Oil	42
Closed Indirect Heating Plant Solves Oil Emulsion Treating Problem in the Luling Field — By J. L. Massie	44
Unusual Method of Connecting Steam Line to Slush Pumps	48
Distribution Transformers and Their Protection — By W. C. Lane	50
Combating Corrosion in Sucker Rod Service	54
Big Spring and Other Fields in West Texas and Southeastern New Mexico Offer Varied Problems in Limestone Reservoirs	66
Deep Test in Texas Gulf Coast	102

REFINING AND NATURAL GASOLINE MANUFACTURE

Multiplicity of Processing Methods Feature Refinery — By J. C. Albright	25
Production of Premium Diesel Fuels (Part 2) — By Geo. M. Woods	58
Automatically-Controlled Absorption-Type Gasoline Plant Embodies Many Features — By Frank H. Love	74
Extraction of Paraffin Wax from Crude Oil — By R. Fussteig	90

OIL AND GAS TRANSPORTATION

Application of Gas Engine-Driven Generators for Protection Against Pipe Line Electrolysis — By A. H. Blackmore	31
Low Crankshaft Bearings Result in Misalignment — By Jos. L. Ingram	65
Control of Galvanic Electrolysis on Large-Diameter Gas Lines — By Dave Harrell	68

GENERAL

Fuel Injection and Combustion Systems in Diesel Engines — By Orville Adams	37

REGULAR DEPARTMENTS

The Course of Oil	7
Highlights in Oildom	8
The Month's Activities in Refining	10
Latest Activities in the Oil Fields	12 and 14
Progress of Major Pipe Line Work	16
Pictorial Petroleum	81
FUN-Da-Mentals	96
Running Tour with Men in the Industry	98
Laugh with Barney	100
Machinery and Equipment	102, 104, 105, 106, 107, 108, 109, 110, 111 and 112
Trade Literature	118
Trade Personals	119

Meetings

- California Natural Gasoline Association—January 7, Richfield Building, Los Angeles, California.
- Society of Automotive Engineers—January 11, 12, 13, 14 and 15, Book-Cadillac Hotel, Detroit, Michigan.
- Mining and Metallurgical Society of America—January 12, New York City.
- American Society for Testing Materials, 1937 Regional Meeting and Committee Week—March 1, 2, 3, 4 and 5, Palmer House, Chicago, Illinois.
- American Association of Petroleum Geologists, 22nd. Annual Convention—March 17, 18 and 19, Biltmore Hotel, Los Angeles.
- American Institute of Mining and Metallurgical Engineers, Open Hearth Conference — April 7, 8 and 9, Birmingham, Alabama.
- Petroleum Industry Electrical Association—April 8, 9 and 10, Shreveport, Louisiana.
- American Gas Association, Natural Gas Department—Week of May 10th, Kansas City, Missouri.
- American Petroleum Institute, Mid-Year Meeting — June 1, 2 and 3, Broadmoor Hotel, Colorado Springs, Colorado.
- Oil-World Exposition, Inc. — October 11, 12, 13, 14, 15 and 16, 1937, Houston, Texas.
- International Petroleum Exposition —May 14, 15, 16, 17, 18, 19, 20 and 21, 1938, Tulsa, Oklahoma.

THE PETROLEUM ENGINEER PUBLISHING COMPANY

Seventh Floor Allen Building DALLAS, TEXAS

NEW YORK CITY
T. J. Crowley
Vice-President
101 Capitolian Blvd.
Rockville Center
Long Island, N. Y.

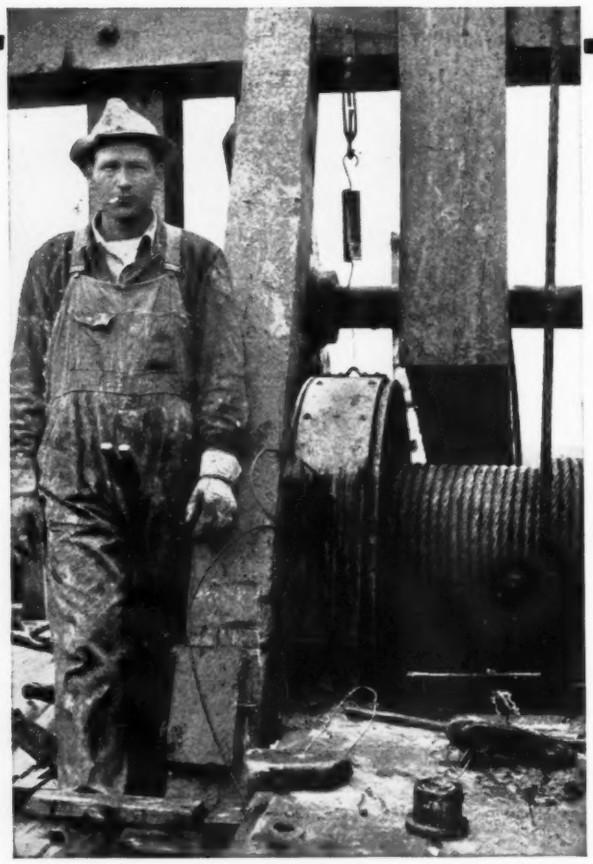
C. Morris — *President-General Manager*
J. L. Dwyer — *Vice-President*
W. T. Bryan — *Secretary-Treasurer*
W. L. Love — *Vice-President and Adv. Mgr.*
C. R. Barrett — *Circulation Manager*
K. C. Sclater — *Editor*
Frank H. Love — *Associate Editor*

LOS ANGELES, CALIF.
R. C. Wipperman
West Coast Representative
1311¾ North Hayworth
West Hollywood, Calif.
Telephone: HEmpstead 1885

MEMBER A. B. C.—MEMBER A. B. P.

Copyright, 1936, by The Petroleum Engineer Publishing Co.

HERE'S ONE FOR THE RECORD BOOK
READ WHY "CURLY" TRAXLER SAYS . . .



The above photo of Mr. H. G. "Curly" Traxler, driller, was taken at the H. H. Howell Drilling Company's rig No. 2 at Clarkwood, Texas.

"In All My Years of Drilling I Have Never Seen Its Equal".

From Mr. H. G. "Curly" Traxler, driller for the H. H. Howell Drilling Co., of Clarkwood, Texas, comes this report on the remarkable service he is receiving from one of our 1⅛", 6x19, "HERCULES" **(Red-Strand)**, Seale Construction, Wire Rope Center, Preformed Rotary Lines.

"This line was put on during a fishing job, at which time it was necessary to pull to such an extent that two weight indicators were pulled completely apart. No one will ever know just how much pull was put on this line, but we do know that it must have been many hundreds of thousands of pounds. After using this same line for 48 days of fishing, it was then used to drill 6 complete wells (two 4,575 feet, two 4,575 feet and two 4,450 feet), all double reamed. This line is still on the job and going strong."

Our thanks to Mr. Traxler and to the thousands of other users, who are enjoying similar experiences. You too, will find that "HERCULES" **(Red-Strand)** Wire Lines are gluttons for work.

Made Only By **A. LESCHEN & SONS ROPE CO.** Established 1857

5909 Kennerly Avenue, St. Louis, Missouri

New York Chicago Denver San Francisco Seattle

Domestic Distributors:

CASEY & NEWTON
901 Century Bldg., Pittsburgh, Pa.

GULF HARDWARE & SUPPLY CO.
Corpus Christi, Texas

GUSTIN-BACON MANUFACTURING CO.
Kansas City
Fort Worth Houston Tulsa

F. HAMILTON CO., *Inc.*
Bradford, Pa.

HERCULES SUPPLY COMPANY
Fort Worth, Texas

HILLMAN-KELLEY, *Incorporated*
2441 Hunter St., Los Angeles, California

HINDERLITER TOOL COMPANY
Tulsa, Oklahoma

NORVELL-WILDER SUPPLY COMPANY
Beaumont, Texas

OSBORN MACHINERY COMPANY, *Inc.*
Clarksburg, W. Va.

PARKERSBURG SUPPLY COMPANY
Parkersburg, W. Va.

STRAKER & TROUT
Mt. Pleasant, Mich.

UNION PIPE AND SUPPLY CO., *Inc.*
Owensboro, Kentucky

UNITED PIPE AND SUPPLY CORP.
Charleston, W. Va. Paintsville, Ky.

Export Distributor:

CONTINENTAL EMSCO COMPANY, *Inc.*, No. 30 Rockefeller Plaza, New York, N. Y.
Branches: Buenos Aires — London — Ploesti

The Course of Oil

By K. C. SCLATER

Excessive Drilling and Economics

How to stop the practice of drilling more wells than are really necessary for economic recovery is a problem the solution of which eventually must lie in the universal application of sound engineering principles of oil development and production. A more candid acceptance of these principles by all operators and those responsible for the regulation of oil, regardless of any controversial issues that may be involved, is sadly needed.

When production is prorated on a potential basis without regard to the acreage drained, a premium is placed on new drilling, which if persisted in, will result in allowables being reduced to the point that the production of oil becomes unprofitable. By allowing such a point to be reached the stability of production is threatened; a howl goes up for increased allowable, which, if not granted, will breed trouble.

Chairman of the Compact Commission, E. O. Thompson, who also is chairman of the Texas Railroad Commission, defended Texas' action in increasing its allocation of crude production for December beyond the Bureau of Mines' recommendation on the grounds there was a greater demand for the oil. It is difficult to reconcile the stand taken by Chairman Thompson in this instance with his ardent desire to give the American people cheap gasoline, for as he himself says, "It is the purpose of true conservation as it applies to oil and gas, that the rules and regulations of the regulatory body shall be based upon those scientific principles which will, when carried out, cause to be left in the sand down in the reservoir beneath the surface of the earth just as little oil and gas never to be recovered as is *within the bounds of reason* (the italics are ours) humanly possible." His qualifying phrase, "within the bounds of reason," in the foregoing statement implies, even though vaguely, that there might be an economic limit to the number of wells that should be drilled on a tract to recover the oil beyond which drilling is an unnecessary expense. Assuming—as Chairman Thompson apparently does—that the greater the number of wells drilled the greater the ultimate recovery of oil, a field might be drilled so densely that the development would approach that of a mining operation in which all the productive sand is brought to the surface and the oil extracted. This is carrying out oil recovery from the sand to the *n*th degree, but it is cited only as an extreme example of what might be attempted—when the economics involved in the operation are neglected. The cost of recovery by such a scheme of development for deep fields, even though practicable, would be prohibitive.

Why then dodge the fact that there is such a thing as an economic limit to the number of wells that should be drilled on any tract to recover the oil that underlies it? Holding to this economic limit will enable the operator to obtain the greatest ultimate recovery at the lowest cost per barrel. Any deviation from this economic limit would result only in increasing the cost of recovery. No operator, unless he were of the most unscrupulous type or had some ulterior motive, would wish to produce at a higher cost unless forced by circumstances to do so. But were the practice universally adopted of not drilling wells beyond the economic limit the cost of oil recovery would be much lower than it is today; and it is logical to assume that the price of petroleum products to the American people would, in turn, be less than it is today. The interests of producer, the state, and the consumer are not in conflict.

Unfortunately, circumstances over which the operator has no control often intervene that prohibit him from following development and production practices that would result in the greatest ultimate *economic* recovery of oil.

Chairman Thompson seems to be more concerned over possible ulterior motives of producers than economic principles of production that would reach his desired objective of preventing actual physical waste in the production of oil and gas, when he says: "There is a very distinct difference between preventing actual physical waste in the production of oil and gas and the saving of money for those who produce the same. There are those in the industry who would like very much to be compelled themselves, and to have others compelled, to spend less money by allowing them to drill far fewer wells, or rather I should say, by denying them the privilege to drill more wells than they would like to drill as a mere money-making proposition."

Excessive drilling, assumed here to be the drilling of wells beyond the economic limit, today is a by-product of inequitable and unsound proration methods. Price of oil and proration are perhaps the most important factors that enter into the determination of the number of wells that should be drilled for efficient recovery. In general, the higher the price of oil the greater the number of wells; and the less the allowable production the smaller the number of wells. One of the aggravating weaknesses of proration is that it may, and usually does, tend to encourage drilling beyond the economic limit. In defending an increased allowable beyond the U. S. Bureau of Mines recommendation, Chairman Thompson prefers to stress the fact that a greater demand exists, but ignores entirely the economics of drilling in refusing to consider whether the ultimate recovery might be reduced and the production costs increased by meeting such a demand. A high daily rate of production is not synonymous with a high ultimate recovery; a higher daily rate of production may result in lower ultimate recovery and higher production costs. Actual physical waste in the production of oil and gas is at the minimum not when the market demand is met but when sound principles of production are followed.

Whatever the means adopted for eliminating unnecessary drilling, a permanent cure, based on sound economic principles, should be aimed at.

« « HIGHLIGHTS IN OILDOM » »

Crude Advance of 17 Cents Per Bbl. Announced

The Continental Oil Company, Ponca City, Oklahoma, announced on December 4th an advance of 17 cents per bbl. in the price of crude effective January 4, 1937, in areas in which it is a large purchaser. The advance will affect Kansas, Oklahoma, North Texas, and Rocky Mountain areas, bringing the top price on 40-gravity crude and above to $1.35 a bbl. in Oklahoma, Kansas, and Rocky Mountain states. In North Texas the new posting will be $1.25 a bbl. for crude of 40 gravity or above. The usual 2-cents differential on crude of less than 40 gravity will be maintained.

In making the announcement, President Dan Moran of the Continental Oil Company expressed the opinion that the statistical position of the oil industry justified an increase in the price of crude.

"The bases for such a decision," said Moran, "are definitely reflected in the drastic declines in crude inventories, the splendid co-operative spirit exemplified among compact states in their proration proceedings, and the unusual competitive demand for pipe line connections.

"A war among producers is imminent unless fair recognition is given their continued adherence to reduced allowables in isolated fields where special treatment will be required to perpetuate the balance that must be maintained among producing states and the law of supply and demand. The producer deserves compensation for this adherence to various conservation programs and a better price will, undoubtedly, lessen protests against localized reductions in allowables."

Since the announcement several companies have stated they will follow the lead of the Continental. Others have made no official announcement regarding what their official course may be.

●

Pressure Drop in East Texas

Latest readings taken in the East Texas field by the Railroad Commission reveal that the average reservoir pressure in the area declined 4.65 lb. during the previous 30-day period. Readings were taken on 34 key wells. The drop placed the average for the field at 1179.85 lb., or a loss of 20.97 lb. since the January, 1936, tests were made.

●

Possibility of New Fields in Egypt

Interest is being shown in the possibility that Egypt may prove to be an increased source of petroleum. Some time ago the Shell Company of Egypt surveyed various areas in the Western Desert and along the coast of the Red Sea and filed on these claims with the Ministry of Finance.

At present oil is produced in Egypt by the Anglo-Egyptian Oil Fields, Ltd., an Egyptian subsidiary of the Shell. The wells, situated at Hurghada on the Red Sea, are producing some 190,000 metric tons annually. This oil is transported to Suez in small tankers, refined, and sold in Egypt.

Several difficulties confront companies considering petroleum exploitation in Egypt. The first question to be settled is that of legislation governing drilling activities. Existing laws are antiquated and the position of claimants to certain areas for mining purposes never has been defined clearly. Furthermore, considerable confusion exists regarding the definition of the rights of the owner of the surface soil with respect to the subsoil. To remedy this condition, and to establish a sound basis upon which the Egyptian Government may consider applications for future drilling concessions, a new regulation has been drafted in committee. This drafted law is now on the desk of the Minister of Finance for his consideration.

●

To Appeal Ruling in Spacing Case

An appeal will be taken to the Supreme Court of the United States in the J. O. Whittington case involving the validity of the Texas Railroad Commission's Rule 37 regulating spacing of oil wells, it has been announced by Harry Pollard, assistant attorney general.

In 1934 Whittington sued for an injunction against a commission order denying him a permit to drill a well in the East Texas field. He obtained a temporary injunction that later was set aside on a motion for rehearing. He then attacked an order of the commission that directed him to cease producing the well, and alleged invalidity of Rule 37. Eventually he was denied a permanent injunction.

In announcing its findings the court said:

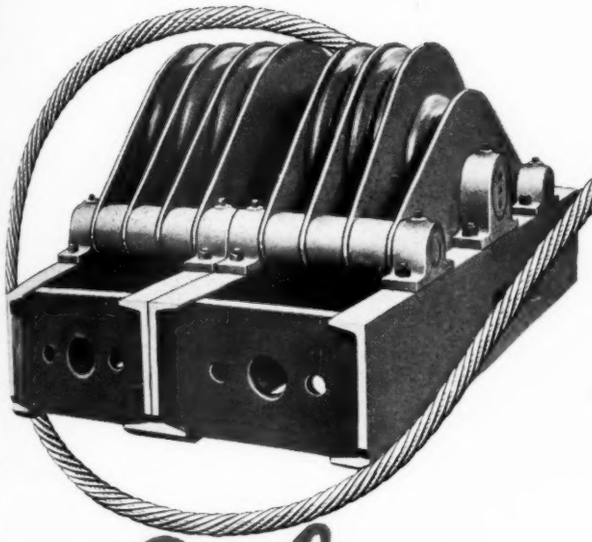
"The Railroad Commission of Texas has jurisdiction over all persons, associations, or corporations owning or engaged in drilling or operating oil or gas wells in the State of Texas, but only for the purpose, and to the extent necessary, to prevent the waste of said natural resources. Said commission is authorized to make rules and regulations or orders for the drilling of wells and preserving a record thereof, and to require wells to be drilled and operated in such manner as to prevent waste. Rule 37, as amended, is a valid order of the Railroad Commission and is not unconstitutional either under the Constitution of the United States or under the Constitution of Texas."

●

Seek New California Law on Drilling

Petitions have been circulated in California within recent weeks addressed to the State Legislature, asking for the enactment of a measure pertaining to drilling in the state. Provisions of the measure would: (1), prohibit beach drilling; (2), prohibit surface drilling on tide, overflowed, and submerged lands; (3), create a state mineral commission; (4), prescribe the commission's authority including the power of eminent domain; (5), direct the commission to grant an operating contract to Independent Producers, Inc., to drill for oil beneath tide, overflowed, and submerged lands by slant drilling from uplands; (6), provide that the state shall receive 40 percent of the net proceeds of the development; (7), make an appropriation to carry out the provisions of the proposed law; and, (8), repeal all conflicting legislation.

The sponsors of the proposed measure must obtain signatures of legal voters equal to five percent of the vote cast at the last election, or 116,000 signatures. Should this be done the Legislature may enact the proposed law upon receipt of the petition, and in that event no popular vote would be required. Otherwise the proposal would be voted upon at the next election.



BREWSTER BLOCKS ARE NOW *"Americanized"*

ARE *You* USING THE BEST ROLLER BEARING FOR HEAVY DUTY DRILLING?

There are five clear-cut reasons why you should use American Roller Bearings on your heavy-duty drilling equipment:

American Bearings are easy to install. Once installed, they never need adjustment. Their design is extremely simple and compact. They are made of the best bearing steel known to the industry. They reduce friction and power loss to the minimum.

Almost all of the leading manufacturers of heavy-duty drilling equipment use these bearings as standard. No American Bearing application has ever been replaced. We invite your inquiries on any type of installation.

AMERICAN ROLLER BEARING CO. • PITTSBURGH, PA

Pacific Coast Office: 321 W. Pico St., Los Angeles, Calif.

★ AMERICAN ★

Heavy Duty ROLLER BEARINGS

The Month's Activities In Refining

Percent Refinery Capacity Operated

Western Division, 66.8 Percent **Central Division, 77.1 Percent** **Eastern Division, 84.0 Percent**

THE Chalmette Petroleum Corporation will virtually double the capacity of its refinery below New Orleans, Louisiana, according to a recent announcement. The company has started construction of a new cracking plant having a capacity of approximately 9000 bbl. daily. The existing cracking unit is being converted into a topping plant. The new cracking plant was designed by the M. W. Kellogg Company and it will be licensed by the Gasoline Products Company, Inc., having the right to operate under all licenses controlled by that company. The construction work is being done by Arthur G. McKee and Company of Cleveland, Ohio, and the plant will be ready for operation on or about February 15, 1937.

The geographical location of the Chalmette refinery is such as to give it the advantage of both water and rail transportation. All Chalmette's raw material is shipped into New Orleans by water. The plant will operate almost exclusively on Coastal Louisiana crudes, it is announced.

●

Construction of a 4000-bbl. refinery at Trenton, Michigan, near Detroit, will be started this month by the Dixie Refining Corporation, a new concern, it has been announced. The plant is expected to be completed in eight months.

●

The Phillips Petroleum Company plans to construct an absorption-type natural gasoline plant in the west extension area of the Rodessa field, in Cass County, Texas. The plant will have a minimum capacity of 50,000,000 cu. ft. of gas daily and will be erected by the company on its Farrier lease.

Equipment for the extraction of butane is being installed in a number of gasoline plants in the East Texas field, including that of the Hanlon Gasoline Company, the Parade Gasoline Company, Lisbon Gasoline Company, Gregg-Tex Gasoline Company, and the Hercules Gasoline Company, Inc.

The Hanlon gasoline plant near Gladewater is installing the equipment necessary for the extraction of 95 percent of all butane contained in the incoming gas. Equipment consists of three 230-hp. Cooper-Bessemer twin-cylinder compressors as the propane refrigerating units, a tail absorber, a second distillation unit, and all appurtenances.

The Gregg-Tex plant also will be equipped for the extraction of 95 percent of all butane. Due to the type of plant, however, which necessitates the sub-cooling of gas from the recovery columns, it will be necessary to erect two 250-hp. refrigerating units and necessary appurtenances.

The Parade Gasoline Company in the south end of the field is installing the same type equipment as Hanlon.

The Lisbon Gasoline Company's Moore plant, also in the south end of the field, is of the vapor-rectification type, and there the necessary absorption equipment to process gas from the recovery columns is being installed.

At the plant of the Hercules Gasoline Company, Inc., near Kilgore a butane tower, cooling equipment, reflux container, and all equipment required in the extraction of butane are being constructed.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks
Week Ended November 28, 1936
A.P.I. Figures

(Figures in Barrels of 42 Gallons Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	514,000	84.0	14,091	11,923
Appalachian	94.8	110,000	75.3	2,158	667
Ind., Ill., Ky.	96.2	423,000	92.6	8,542	6,219
Okla., Kans., Mo.	84.8	280,000	72.9	5,676	3,499
Inland Texas	48.5	112,000	70.0	1,681	1,726
Texas Gulf	97.0	642,000	90.4	7,407	8,714
La. Gulf	96.4	117,000	71.8	1,436	2,175
No. La.-Ark.	90.0	57,000	79.2	266	433
Rocky Mt.	61.9	43,000	71.7	899	784
California	92.6	489,000	62.0	11,699	73,610
Reported	89.9	2,787,000	78.4	53,855	109,750
Est'd Unreported	.....	233,000	.....	3,593	2,275
*EST'D TOTAL U. S. Nov. 28, '36	.....	3,020,000	.....	57,448	112,025
*EST'D TOTAL U. S. Nov. 21, '36	.....	2,995,000	.....	56,670	111,762
U. S. B. of M. *Nov. 28, 1935	.....	**2,773,000	.....	51,896	108,921

*Estimated Bureau of Mines basis.
**November, 1935, daily average.

●

The new refinery of the Chosen Sekiyu Kaisha (Chosen Petroleum Company) at Genzan, Japan, has been completed and is now operating. The first receipt of crude oil was 84,000 barrels.

●

The 5000-bbl. refinery that Eugene Constantin of Dallas is constructing in the Talco field of Texas is expected to be completed by Christmas, according to recent reports.

We EXPAND ★ ★

● WE WISH TO ANNOUNCE OUR REMOVAL TO THE

ALLEN BUILDING

WHERE WE WILL OCCUPY THE ENTIRE EAST WING OF THE SEVENTH FLOOR

WE INVITE YOU TO VISIT US IN OUR NEW HOME AFTER DECEMBER 26th

THE PETROLEUM ENGINEER

7th FLOOR ALLEN BUILDING ★ DALLAS, TEXAS

Latest Activities In The Oil Fields

INTEREST has been revived in the Frederick area of Tillman County, Oklahoma, by the Indian Territory Illuminating Oil Company and the Foster Minerals Corporation's No. 1 Hatler, which appears to be the discovery well of a new pool. The test originally was drilled to a total depth of 3829 ft., but since has been plugged back to 3800 feet. During the initial test, covering a period of 15 minutes, the well's flow indicated an output of 60 to 70 bbl. of crude an hour.

●

Successful completion of the Sinclair-Wyoming Oil Company's No. 2-C Muskrat, near Riverton, Fremont County, Wyoming, in the Muskrat gas field, is expected to open a new black oil field. The test was drilled to a depth of 7293 ft. in the Embar lime, and the hole filled with oil to a depth of 3000 feet.

●

A new oil field is in prospect for Jefferson County, Texas, in the Gulf Coast area. The Sun Oil Company's No. 2 Hebert Broussard on the LaBelle prospect approximately 12 miles southwest of Port Arthur cored sand at 8217 ft., showing oil. Following an electrical survey of the hole the operators prepared to set casing for a production test.

●

In Washington Township, Greene County, Pennsylvania, a new oil pool has been opened. The Crayne Run Gas Company, in deepening its No. 1 on the Jacob Johns farm, almost two miles north of Ruff Creek Crossing, found oil at 2685 ft., the well flowing 100 bbl. in the first flow. The nearest production is four miles distant.

●

When the Standard Oil Company of California's wildcat midway between Rio Bravo and Rosedale, California, cored 35 ft. of saturated oil sand it apparently opened a new oil pool for Kern County. The well, No. 11-1 K.C.L., has been drilled to a total depth of 7842 ft., and at latest reports preparations were being made to cement casing and make a production test.

An important discovery in the Rocky Mountain area is the finding of oil by the Mountain Fuel Supply Company with their No. 1 Allen in Colorado, northern Moffatt County. Producing from the Lower Wasatch at a depth of 5032 ft., the well initially flowed between 1000 and 1500 bbl. daily, opening a new field.

●

Two new fields in Michigan are causing a rush of activity in that area. The McClanahan Oil Company discovered one pool with its No. 1 C. W. Seignious, Jr., in Clayton Township, Arenac County. During the first week following completion the well averaged approximately 850 bbl. of oil daily. The Daily Crude Oil Company's No. 1 Weatherby, near Howard City, Montcalm County, after being drilled to 3311 ft. flowed by heads, indicating the possibilities of a new pool in the Monroe formation.

●

Several new pools have been discovered in Kansas. Taylor et al's No. 1 Emery, 15 miles southeast of Hays in Ellis County, filled 500 ft. with oil in five and one-half hours after being drilled to a depth of 3570 feet. The L.C.D. Drilling Company et al's No. 1 Westhusin, five miles northeast of Plainville in Rooks County, has opened the fifth pool for that county. At a total depth of 3205 ft. the well pumped and flowed 504 bbl. of oil in 24 hours on the initial test. Later it was deepened and completed at 3243 feet. Six miles north of Hoisington in Barton County the Vernon Oil and Gas Company and M. B. Armer have given Kansas another Arbuckle lime pool with their No. 1 Ainsworth. Total depth of the hole is 3395 feet.

●

Duval County, Texas, has a new Loma Novia sand producing area as a result of the Bridwell Oil Company and the Gorman and Yoakum Drilling Company's No. 1 W. K. Hoffman test, about a mile east of the Hoffman field. Tests indicate the opening of a new sand lens east of the field. Considerable activity is likely to result.

AVERAGE CRUDE PRICES

California		Louisiana	
Kettleman Hills	$1.22-1.43	Gulf Coast	$ .82-1.22
Playa Del Rey	1.10	North Louisiana	.86-1.10
Coalinga	.70-.90	Illinois	1.23
Signal Hill	1.10	Kentucky	1.28
Montana	1.35	Indiana	1.12
Wyoming	1.10	Ohio	
Colorado	1.00-1.10	Lima	1.15
New Mexico	.75-1.00	Michigan	.70-1.32
Texas		Pennsylvania	
North Central	.84-1.08	Bradford	2.45
Panhandle	.81-.98	Southwest	2.17
West Texas	.75-.95	Eureka	2.12
Gulf Coast	.85-1.30	Buckeye	1.97
Darst Creek	.88-1.22	Corning	1.32
East Texas	1.15	West Virginia	1.67
Kansas	1.10	Canada	2.10-2.17
Oklahoma	1.10		
Arkansas	.75-.80		

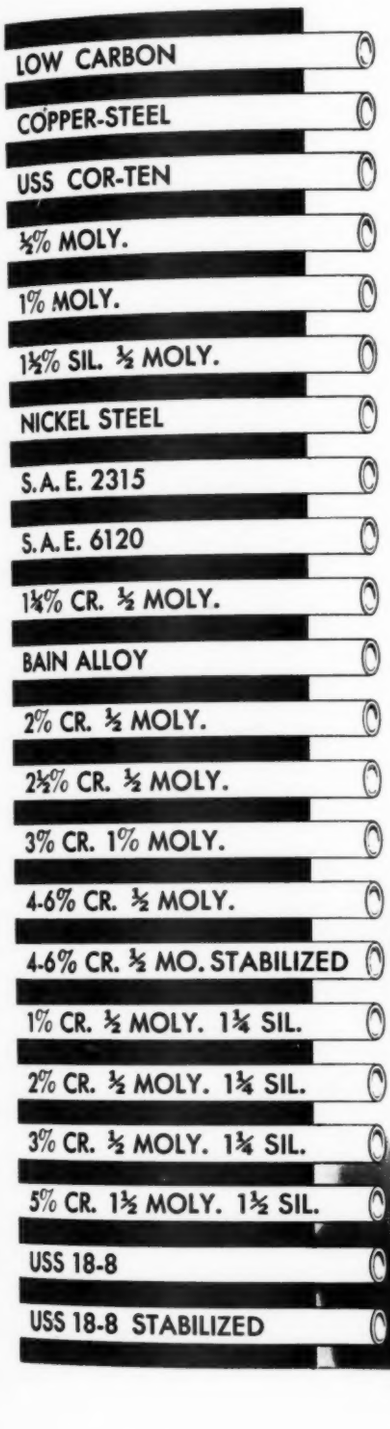
DAILY AVERAGE CRUDE OIL PRODUCTION
Data Supplied by A.P.I.

(Figures in Barrels)

	B. of M. Dept. of Interior Calculations (November)	Week Ended Nov. 28, 1936	Week Ended Oct. 31, 1936	Week Ended Nov. 30, 1935
Oklahoma	558,400	568,100	564,750	484,700
Kansas	154,500	165,400	163,400	145,800
Panhandle Texas	.....	63,450	65,950	67,100
North Texas	.....	64,650	65,300	61,050
West Central Texas	.....	33,600	33,800	32,050
West Texas	.....	152,600	170,100	157,600
East Central Texas	.....	76,950	71,100	45,400
East Texas	.....	443,150	439,650	434,000
Southwest Texas	.....	170,350	169,950	109,000
Coastal Texas	.....	151,950	178,100	161,750
TOTAL TEXAS	1,109,300	1,156,700	1,193,950	1,067,950
North Louisiana	.....	77,500	75,450	34,550
Coastal Louisiana	.....	157,900	157,800	126,700
TOTAL LOUISIANA	198,600	235,400	233,250	161,250
Arkansas	28,100	27,800	28,100	29,700
Eastern	108,400	113,250	117,050	104,700
Michigan	29,000	29,750	31,200	49,650
Wyoming	40,100	43,500	40,400	36,550
Montana	14,300	17,950	15,750	13,150
Colorado	4,400	3,400	4,950	4,150
New Mexico	75,600	83,300	83,100	57,850
TOTAL EAST OF CALIF.	2,320,700	2,444,550	2,475,900	2,155,450
California	549,600	566,100	567,600	665,000
TOTAL U. S.	2,870,300	3,010,650	3,043,500	2,820,450

22 Different Analyses of Steel for Refineries

. . . a COMPLETE Tube Service



HERE—*available from one source*—are the most improved pipe and tubes for refinery service. They cover the entire range of applications in the most modern plant. Here are regular carbon steel tubes, low chromium and 4% to 6% chromium tubes, with molybdenum, titanium and other alloys and high chromium, high-nickel steels. Tubes for every service — available in 22 analyses of steel—from which you may select the one best suited for each particular use you have in mind. Tubes that assure you the greatest economy and safe, dependable operation.

Here is a complete tube service—based on our intimate knowledge of the needs of the refinery operator. Remember it when you are equipping your stills, furnaces, hot-oil lines, heat exchangers, or when tubes and piping or other high temperature and sub-zero work are under consideration.

The superior pipe and tubes that NATIONAL offers you are made of the highest quality steel. They embody the chemical composition and physical properties that will give you these desirable qualities: Resistance to corrosion. Resistance to oxidation and scaling. Ductility for bending and forming. The necessary strength for high temperatures and high pressures.

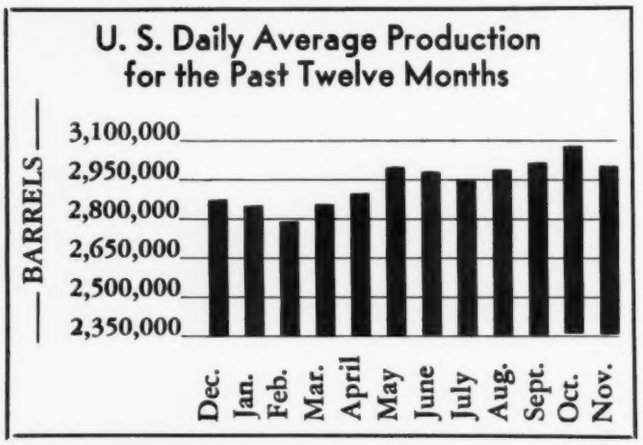
Take advantage of this complete tube service. It has the experience of the largest manufacturer of tubular products in the world behind it. Call in NATIONAL engineers and metallurgists to help you. Also send for bulletin "Properties of Steel Pipe and Tubes Applicable to High Pressures and High Temperatures."

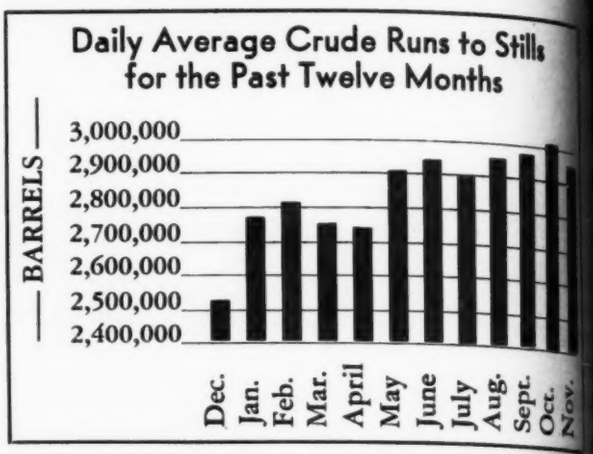
NATIONAL TUBE COMPANY

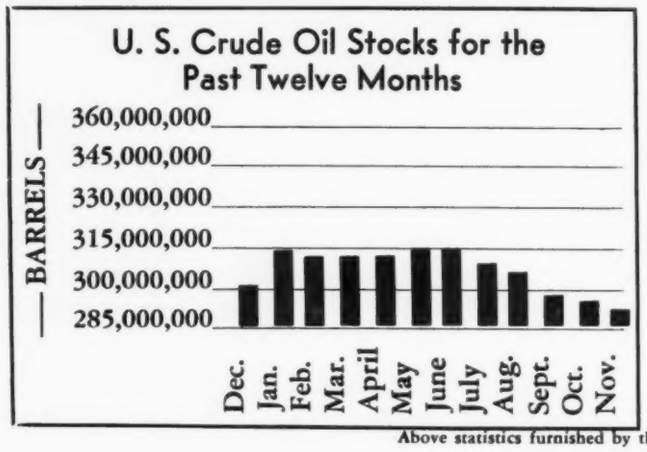
PITTSBURGH, PA.

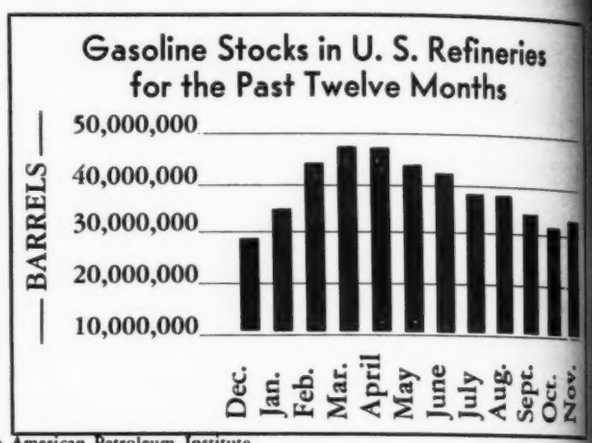
Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL









Above statistics furnished by the American Petroleum Institute.

Summarized Operations in Active Fields for November, 1936

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	179	168	56	90	3500-3700	2	40	Rotary
Duval County	83	71	27	56	1554-2900	2	22	Rotary
Archer County	36	14	5	15	660-1800	1 or 2	40	Rot.-Cab.
Panhandle	52	50	30	135	1700-3900	2	40	Rotary
Refugio County	8	8	3	10	4900-5900	2	38	Rotary
Nueces County	58	54	13	55	3922-5878	2 or 3	21-54	Rotary
San Patricio County	10	8	4	8	3987-6141	2	23-65	Rotary
Talco	23	23	13	35	4230-4361	2	16-24	Rotary
OKLAHOMA								
Oklahoma City	6	6	2	3	6450-6682	3	39	Rotary
Fitts Pool	42	37	10	66	1800-4488	2 or 3	38	Rotary
Osage County	16	15	6	28	380-2850	2	37.5-40	Rot.-Cab.
KANSAS								
McPherson County	5	5	4	15	2900-4300	2	38	Rot.-Cab.
Russell County	19	19	7	53	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	22	19	7	49	3222-4085	2 and 5	42-48	Rot.-Cab.
Reno County	19	15	6	20	3300-4375	2 and 5	42-48	Rot.-Cab.
LOUISIANA-TEXAS								
Rodessa	38	38	11	75	5950-6450	3	39	Rotary
CALIFORNIA								
Kettleman Hills	1	1	7	18	8300-8730	3 or 4	40	Rotary
Midway-Sunset	9	9	16	24	1400-3100	1 and 2	11-30	Rot.-Cab.
Mountain View	3	3	6	11	5200-6000	2	20-40	Rotary
Montebello	5	5	3	6	5000	2	36	Rotary

Field Activities by States for November, 1936

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1935 (In Barrels)
	November	October	November	October	November	October	November	October	November	October	
Arkansas	5	4	0	1	10	10	9	7	36	35	11,140,750
California	66	75	56	59	75	108	108	80	256	244	207,899,480
Colorado	5	3	3	2	....	....	3	2	25	29	1,565,150
Illinois	9	10	5	6	....	....	26	28	18	19	4,352,000
Indiana	5	12	4	8	....	....	3	2	23	25	762,000
Kansas	144	136	110	105	150	215	50	54	348	397	53,013,450
Kentucky	10	20	4	20	....	....	16	10	45	40	4,860,000
Louisiana	79	91	61	72	64	94	32	44	168	175	50,299,850
Michigan	48	71	29	54	76	66	81	68	143	117	15,661,350
Mississippi	2	....	1	....	....	....	4	3	11	8	Gas Prod.
Montana	24	25	19	20	....	....	4	6	60	58	4,304,100
New Mexico	39	51	38	48	....	....	8	10	110	108	19,195,500
New York	....	....	....	....	....	....	2	2	6	4	3,191,900
Ohio	169	180	139	122	....	....	48	42	176	174	4,234,000
Oklahoma	210	210	157	147	216	271	76	87	492	567	181,152,050
Pennsylvania	....	....	....	....	....	....	31	26	136	151	14,478,000
Texas	1038	1095	798	857	1248	1406	501	566	1473	1502	377,747,205
West Virginia	21	70	20	62	....	....	51	53	202	199	3,818,480
Wyoming	14	10	11	7	....	....	6	5	58	53	13,390,100
Total	1888	2063	1455	1590	1839	2170	1059	1015	3786	3661	970,995,385

TO OUR MANY FRIENDS IN THE OIL INDUSTRY

BAROID PRODUCTS

BAROID: Extra-Heavy Colloidal Drilling Mud

AQUAGEL: Trouble-Proof Colloidal Drilling Mud

STABILITE: An Improved Chemical Mud Thinner

BAROCO: An Economical, Salt Water-Resisting Drilling Clay

FIBROTEX: For Preventing or Regaining Lost Circulation in Drilling Wells

STOCKS CARRIED AND SERVICE ENGINEERS AVAILABLE IN ALL ACTIVE OIL FIELDS

NATIONAL PIGMENTS & CHEMICAL DIVISION
NATIONAL LEAD COMPANY

BAROID
SALES OFFICES
LOS ANGELES
TULSA
HOUSTON

Progress of Major Pipe Line Work

EXTENSIVE expansion of its pipe line system from the Panhandle of Texas to Detroit, Michigan, involving the expenditure of $20,000,000, is planned for 1937 by the Panhandle Eastern Pipe Line Company, J. D. Creveling, president, has announced. The bulk of this sum will be spent to add pumping stations and in looping the existing lines. The main line loops will be laid with a view to eventually paralleling the entire system, it is stated.

This increase in the line's capacity has been prompted by a contemplated increase in gas consumption by the city of Detroit and other distributing centers. The present load is 110,000,000 cu. ft. daily, and it is expected that the demand during 1937 will reach 400,000,000 cu. ft. daily.

●

A 120-mile 10-in. gas line will be constructed by the Humble Oil and Refining Company from the Tomball field in Harris County, Texas, to Houston, Port Arthur, Baytown, Beaumont, and Port Neches, the gas to be used industrially. It is scheduled to be completed and in operation by April 1, 1937. The line will have a daily capacity of 60,000,000 cu. ft. of gas.

A combination low-pressure and high-pressure gasoline plant, having a daily capacity of 35,000,000 cu. ft., will be constructed in the Tomball field, stripping the wet gas before it enters the line. Two gathering systems also will be laid.

Later the line will be connected to the Dickinson, Anahuac, and Amelia fields where the Humble has large gas reserves.

●

The 178-mile pipe line of the White Eagle Division of the Socony-Vacuum Oil Company from Augusta, Kansas, to Kansas City, has been completed, the first gasoline going through the carrier late in November. Work began on the line last summer and the project was completed at a total cost of $1,500,000. Two terminals will be provided, however, only the one at Kansas City is now finished. The terminal at Topeka will be completed after the first of the year, and until then gasoline will be shipped to that point from Kansas City by tank car.

The 6-in. line can deliver gasoline at Kansas City at a rate of 550 bbl. an hour. Four grades of gasoline, one grade of kerosene, one grade of heating fuel, one or possibly two grades of power fuel will be pumped through the line.

A booster station is now being completed ten miles north of Emporia.

●

The Magnolia Petroleum Company will lay an 8-in. pipe line from its Tilden station, on the Duval-Karnes County line, to Corpus Christi, Texas, a distance of 85 miles. The line is expected to be completed by February 1st, and is being constructed to relieve a congested condition on the company's Mirando-Luling-Beaumont line in Southwest Texas.

Two additional 80,000-bbl. tanks for crude will be erected at the Tilden station. An intermediate pumping station may be built later between Tilden and Corpus Christi, although for the present, facilities at the Tilden station are sufficient to boost the oil.

At Corpus Christi, Magnolia either will construct its own loading terminal or utilize one of the existing terminals. Definite announcement of plans in this respect has not been made.

The Cosden Pipe Line Company, transportation subsidiary of the Mid-Continent Petroleum Corporation, has under construction an extension from its Cromwell, Oklahoma, station to the Fitts pool of Pontotoc County. The company's existing 4-in. line from the Cromwell station to the Harjo station is being replaced with a 6-in. line, and from the Harjo station to the Fitts pool a 4-in. line is being laid. The work will involve a total of 47 miles of line. At the Harjo station pumping equipment will be added to take care of the increased load. The Sheehan Pipe Line Construction Company, Tulsa, has been awarded a contract to lay the line from Wewoka to the Fitts pool, 22 miles.

●

Compania de Petroleos de Mexico, S. A., has applied to the Mexican Ministry of National Economy for permission to construct and operate a natural gas line from the northern part of the state of Vera Cruz to Mexico City, a distance of 240 kilometers. Officials of the company state they expect to receive the franchise by Christmas and, if so, work on the line will start soon after the first of the year.

●

The Oklahoma Pipe Line Company is taking up 38 miles of 8-in. line between Council Hill and Kinta, Haskell County, Oklahoma. The pipe is being reconditioned and used for the laying of two loops, one from Little River Junction to Cromwell, a distance of 15 miles, the other from Hewitt to the foot of the Arbuckle Mountains, also a distance of 15 miles. The latter loop is being laid by the J. R. Stewart Construction Company, the former by the White Deer Pipe Line Construction Company. All joints are being oxy-acetylene welded by the Lindeweld method. When these two loops are completed crude will move directly from Hewitt to Glenpool, rather than by way of the DeQueen station as formerly. The work is expected to be completed by January 1st.

The Oklahoma Pipe Line Company also is taking up 25 miles of 8-in. line between Smithville, Oklahoma, and the Arkansas state line, which will be reconditioned and stored at Cove and Gillham, Arkansas, for future use.

●

The Dickey Oil Company of Wichita, Kansas, has awarded a contract for the laying of two parallel 4-in. lines, both ten miles in length, to provide outlets for the Graber pool, east of Moundridge, Kansas. One line ties into the company's main line running to its refinery at McPherson, the other connects to the Kansas Pipe Line Company's system at McPherson. The contractor is P. H. Joseph Construction Company. The lines are being laid by the so-called "stab on" method, the joints being oxy-acetylene welded by the Lindeweld method.

●

The Shell Pipe Line Company will lay an oil line from the East Texas field to Houston, Texas, where the company has a refinery, it has been announced. Possibly three stations will be constructed, each having three pumping units. Prime movers will be 500-hp. motors direct-connected through Fast couplings to Allis-Chalmers centrifugal pumps.

●

The B and M Construction Company of Oklahoma City has been awarded a contract by the City of Vicksburg, Mississippi, to lay a natural gas line from that point to Jackson, a distance of 44 miles. The line pipe will be of 6⅝-in. diameter, and the joints will be oxy-acetylene welded by the Lindeweld method.

THE Petroleum Engineer

DECEMBER, 1936

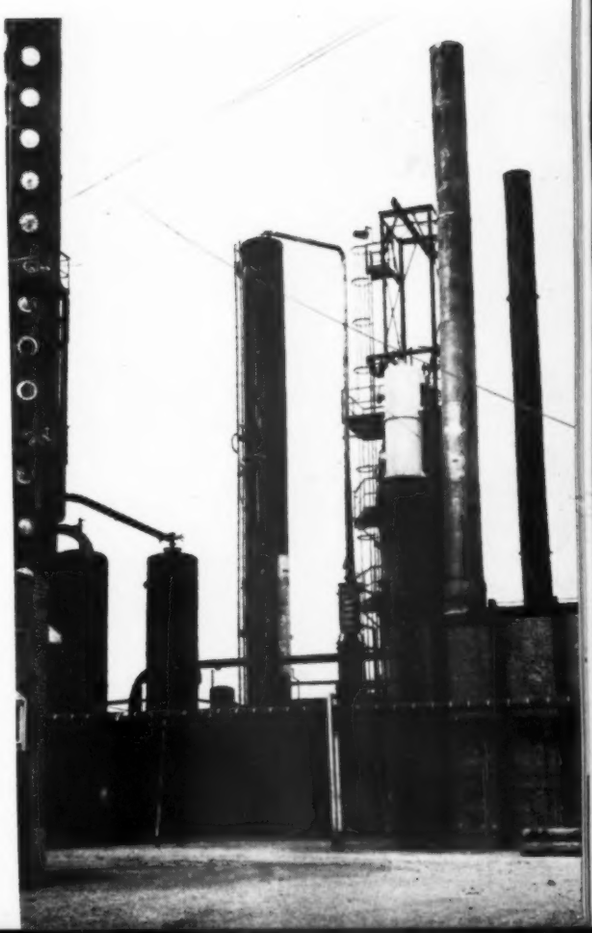
Multiplicity of Processing Methods Feature Refinery

By

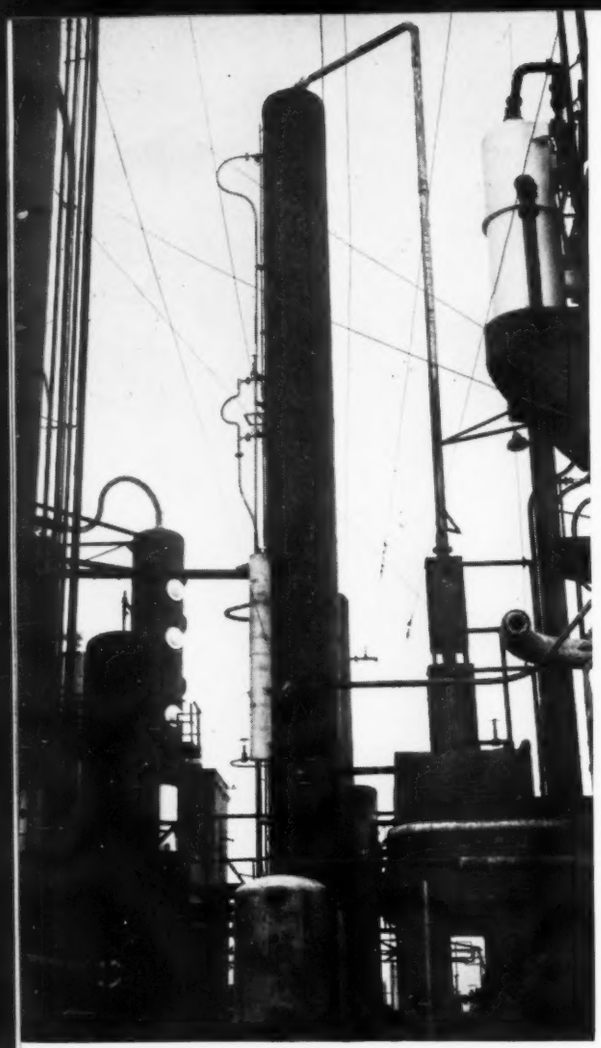
J. C. ALBRIGHT

Four complete units, which can be co-ordinated or operated separately, make possible the manufacture of a variety of products

ARRANGEMENT of the various units in a refinery in a manner that makes possible a multiplicity of processing methods is well illustrated by the plant of the Sunray Oil Company at Allen, Oklahoma. Four separate and complete units have been constructed, beginning with the original battery of shell stills erected many years ago, and in operation at the present time for the reduction of asphalt by blowing and oxidizing. The second unit, a complete skimming plant, was installed about five years ago by the Southwestern Engineering Company to manufacture gasoline, naphtha, kerosene, and asphalt bottoms. The third and fourth units are recent installations, consisting of a Dubbs cracking plant and a Foster-Wheeler vacuum plant. All four units have been, and at the will of the operator, may be, operated simultaneously, although running separate and distinct charging stocks. To round out the operation of the refinery, a vapor recovery unit was constructed by Petroleum Engineering, Inc., as a straight absorption unit to extract gasoline fractions from the uncondensed cracked gasoline vapors. To make the refinery more flexible a column 4 ft. by 72 ft. was erected for operation in conjunction with a Foster-Wheeler heater when running a particularly heavy asphaltic crude produced in the Prague field.



Vacuum unit operated when manufacturing special asphalts



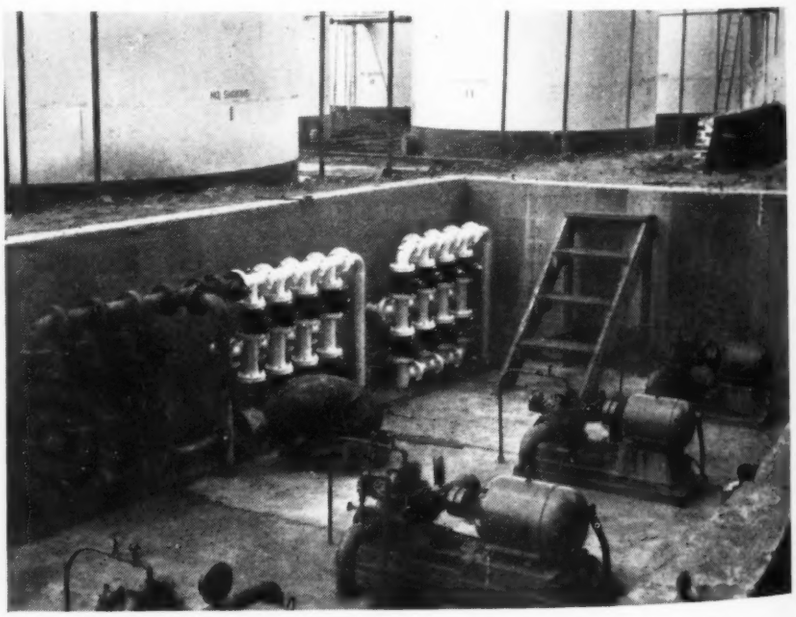
Special 4-ft. by 72-ft. column erected to process Prague crude, connected to Foster-Wheeler heater

One of the operating methods provides for the charging of Allen crude, which has a high asphalt content in the bottoms, directly to the crude oil distillation unit, bringing the charge to a transfer line temperature of approximately 680 deg. fahr., so that all desirable lighter fractions may be taken off the fractionating column either as an overhead product or as side streams through auxiliary strippers. Gasoline, 38-40 distillate,and a 30-gravity gas-oil for cracking are the usual products manufactured from Allen crude when the plant is operated in this manner. The bottoms from the base of the flashing section are transferred while hot directly to the vacuum unit for subsequent processing when manufacturing road oils or asphalt products for various purposes. The oil leaving the distillation unit with a transfer temperature of approximately 680 deg. fahr. provides a bottom temperature of about 550 deg. fahr. on the charge to the vacuum still. As the charge passes through the vacuum plant heater, the temperature of the charge is increased from the initial temperature of approximately 550 deg. fahr. to a processing temperature of approximately 840 deg. fahr., and an applied vacuum of about 28 in. of mercury is maintained.

Three cuts usually are removed from the vacuum column when processing a charge of this character, with the bottom product from the base of the column being processed to asphalt flux, or reduced with time and processing steam to any product desired. On some occasions the bottoms are pumped while hot to the old battery of shell stills for further reduction by oxidizing and blowing. The lighter fractions, as well as the overhead product, usually are combined with the gas-oil stream from the distillation unit, passed through adequate exchangers to obtain a charging temperature of approximately 655 deg. fahr, and pumped directly to the Dubbs plant heater under a pressure of about 520 pounds. With a convection bank temperature of 775 deg. fahr., a radiant temperature of 875 deg. fahr., and a transfer line temperature of 915 deg. fahr., the material being processed enters the reaction chamber at about 250 lb. pressure. Residuum from a charge such as that going to the unit under these circumstances has a gravity of 7.5 deg. A.P.I., a cold test of 45 deg. fahr., and a viscosity of 200 seconds at 122 deg. fahrenheit. In all instances, whether charged with gas-oil or other material, overhead production from the Dubbs unit is controlled to a 400 end-point gasoline. The hot oil pump employed for charging to the tubes of the cracking plant heater is an outside piston packed unit, driven by a gas engine, fitted with fuel injection heads for economy of operation and an increase of hp. rating.

When handling Prague crude, which may be run to the refinery for the recovery of asphalt, the auxiliary column, 4 ft. by 72 ft., is used in conjunction with the Foster-Wheeler heater, removing from service the vacuum equipment by the installation of adequate additional piping so that control gate valves may be used for switching at will the discharge of the transfer line from one to the other. Gasoline content of the Prague crude is small, but what there is, is taken as an overhead stream, while the naphthas and Diesel fuels are obtained by removing them as side cuts from draw-off pans in the column. The volume of lighter fractions removed from the charge depends upon the specifications desired in the bottoms, which may be obtained as material of less than 100 penetration, representing approximately 52 percent of the original charge. Approximately seven percent of the charge, when crude obtained from the wells near Prague is being processed, is manufactured into 400 end-point gasoline, while kerosene may be manufactured up to approximately ten per cent. The remainder of the charge can be processed in the side strippers as a heavy distillate suitable for furnace oils, or cut as a Diesel fuel.

The crude distillation unit also may be operated as a skimming plant, the Foster-Wheeler equipment as a vacuum processing unit, and the Dubbs equipment as a straight cracking plant, with the old-type shell still unit operating



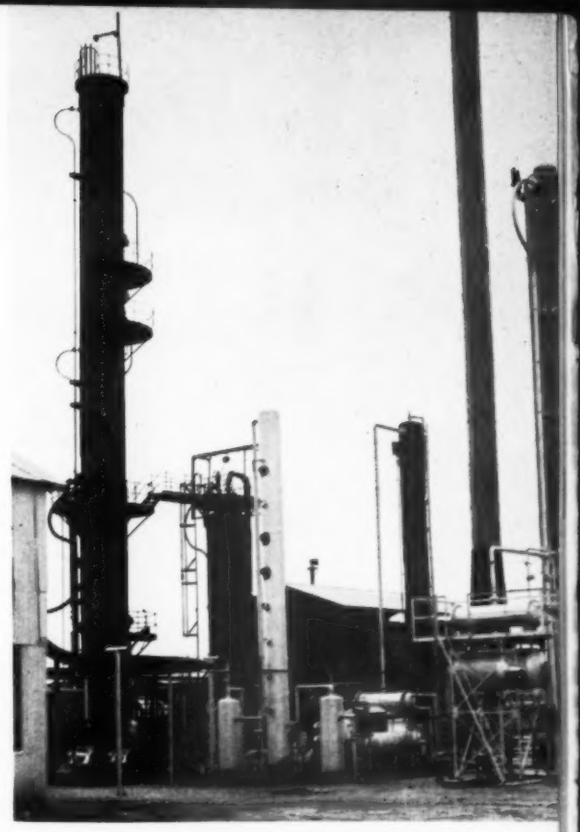
Bank of controls in pump pit, equipped with plug valves so that any stream handled by the pumps at the right may be directed to treating plant, storage, or loading zone

on bottoms to produce the heavier asphalt products. The Dubbs unit has been operated as a complete crude cracking plant, charging any of the stocks at hand directly to the plant without their first being processed in other parts of the refinery. Temperatures and pressures are varied to suit the charge and the desired characteristics of the finished products, but all gasoline, regardless of its origin, is cut to not more than 400 end-point. Vapors from the Dubbs plant, when not condensed in the distillate condensing units, are piped to the vapor-recovery unit and absorbed so that a natural gasoline substitute may be obtained and the overall recovery augmented. When handling fresh, uncontaminated Allen crude through the Dubbs cracking unit without previously distilling it, the recovery of 400 end-point gasoline averages approximately 65 percent. The octane number of this gasoline is 68.5 to 69 and requires only a small treatment with lead to prepare it for the regular gasoline market.

Considerable laboratory investigation has been carried out at Allen by the Sunray Oil Company to select the crude best suited for the particular purpose. Both Prague and Allen crudes are quite well suited as raw charging stocks from which various grades of asphalt products may be manufactured. The Allen crude, from sands found between 800 and 1000 ft., produces a straight-run gasoline with a comparatively low octane number, averaging about 48 when samples were removed from the stream taken from the laboratory pilot plant. Cromwell crude, found at a depth of approximately 2800 ft., has a very satisfactory natural octane rating, the straight-run stream from the pilot plant indicating approximately 69. Crude samples from the Gilcrease sand, at a depth of 2600 ft., have not been entirely satisfactory with respect to contamination, but that thought to be purely Gilcrease crude oil produces a straight-run product having an octane number of approximately 62. The Wilcox sand, at 4100 ft. at Allen, has about the lowest straight-run octane rating of any crude handled by the refinery, showing 45 in laboratory tests.

Some crude production obtained from the Fitts field has been processed in Sunray's Allen plant, and several samples have been analyzed in the research laboratory to determine the relative octane rating of the straight-run gasoline produced from the different sands. Crude obtained from the Wilcox sand at Fitts produces a gasoline with an octane number of 45.0; the Viola, 40.5; the Bromide, 47.0, and the Hunton, 41.0.

With results of laboratory investigations to guide operators of the plant, virtually any product may be manufactured, from high-octane cracked gasoline to heavy asphalt. The plant was so planned and the various units erected in such a manner that when the sales department requires a certain product it easily can be made to specifications and with a minimum loss of time and rerunning. By being able to coördinate the various units, as a group or as detached operation, a variety of products can be manufactured "on the spur of the moment," so to speak.



Vapor-recovery unit in Sunray's plant at Allen, Oklahoma

Power Consumption of Electric Dehydrators in California Oil Fields

POWER requirements for electrical dehydration are a variable factor and depend largely on the character of oil being dehydrated, the size of the dehydrating unit, the type of electrodes used, and the method of operation. The power consumption is due primarily to the conduction of current between the electrodes, and from the electrodes to the dehydrator; and, therefore, does not vary to any great extent with the net throughput.

A survey of power requirements recently has been made by obtaining actual meter readings on 329 electric dehydrators in California. This survey showed a remarkably low power consumption when based on the cost per bbl. of dehydrated oil, averaging about one mil per bbl. of oil recovered. The average power requirements for both the Electroflow (flow-line) and batch (intermittent) treating units as determined by the survey are as follows:

ELECTROFLOW UNITS

5-ft. dia. unit 7.5 kw-hr. per 24 hr.
10-ft. dia. unit 17.0 kw-hr. per 24 hr.

BATCH-TREATING UNITS

10-ft. dia., single transformer unit 45 kw-hr. per 24 hr.
10-ft. dia., double transformer unit 68 kw-hr. per 24 hr.

Although electric dehydrating units are equipped with one or, in some cases, two transformers of 5-kw. capacity, the actual load averages from 0.3 kw-hr. for the 5-ft. dia. Electroflow unit to 1.9 kw-hr. for the 10-ft. dia. double-transformer unit used in the batch-treating method.

The Southern California Edison Company recently made an independent survey of the power requirements of electric dehydrators being supplied with current over their lines, and found a maximum load of three hp. (about 2.3 kw.) per transformer; and as a result established a rate based on a 3-hp. load instead of a 7-hp. (5-kw.) connected load, which is the transformer rating. When the only load connected to the Southern California Edison Company line is an electric dehydrator, the charge for power, based on the 3-hp. load, is as follows:

First 150 kw-hr	4.4c per kw-hr.
150 to 300 kw-hr.	2.4c per kw-hr.
300 to 600 kw-hr.	1.2c per kw-hr.
Over 600 kw-hr.	1.0c per kw-hr.

Minimum monthly charge, $3.00

Where power is used on the lease for other purposes as well as for the electric dehydrator, the cost of power will depend on the total connected load; however, the 5-kw. transformer should be considered as a 3-hp. load when figuring the total connected load on the Southern California Edison Company lines.

Pressure-reducing equipment at Stanolind's well State No. 2. Water supply station in the background

By

JOS. A. KORNFELD

Development Methods in the Dickinson Field

Swampy terrain and high gas pressure present problems and necessitate the exercise of care in drilling—special methods in use of handling high-pressure gas from well

BAYOU development in the coastal district of Texas encounters many physical problems in drilling, completion, and gas-production operations. Construction of substructures on piling, building of board roads, placing of mud pits on the mainland, handling mud to and from the slush pumps and the swivel, and moving-in rig equipment are among a few of the many problems that constantly confront the operator in such areas. Illustrative of this type of development is that of the Stanolind Oil and Gas Company's lease in the heart of the Dickinson oil field of east-central Galveston County.

The lease covers 147 acres on Dickinson Bayou, which extends through the town of Dickinson to the Dickinson oil field three miles southeast where it turns eastward, emptying into Galveston Bay. The property is situated in a marsh where the water averages 15 ft. in depth. The coastal tide affects the depth from 12 to 14 inches.

Derrick Foundations and Substructure. The building of derrick foundations on Dickinson Bayou requires the driving of two sets of pilings, using regulation barge and pile driver. Pilings driven on land are required to be 40 ft. in length, and those driven in the water 45 feet. Nine pilings are driven for each derrick corner, or a total of 36 for the derrick foundation. For the rig substructure two sets of nine pilings each are driven and an additional seven pilings, or a total of 25 pilings.

After the piling is capped, the steel derrick is erected. Derrick girts and beams are moved-in by barge. The derricks used are 132 ft. in height, have a 30-ft. base, and a capacity of 550 tons.

Slush Pits. All slush pits, of necessity, are on the mainland, no portable pits of mechanical construction being used; however, wooden troughs, on some wells as great as 60 ft. in length, are suspended from the substructure to the pits

Rig Specifications. The drilling rigs are among the heaviest ever used in the Gulf Coast district and consist of a 4-speed drawworks equipped with a Hydromatic brake and powered by a 12 by 12 steam drilling engine. Steam is generated in three 125-hp. boilers. Rotary hose tested to 7000 lb. is used. Drilling of the well is begun with six lines, this practice being followed to a depth of 5500 feet. From that depth eight lines, of 1⅛-in. diameter, are employed to depths as great as 9160 feet.

Scene on Dickinson Bayou illustrating the physical difficulties that are confronted in development

Precautions Against Crooked Holes. The maximum deviation from the vertical allowed during drilling is four degrees. The hole is surveyed every 200 ft. to keep an accurate check on verticality. Considering that drilling time averages 65 days, including plug-back jobs, and the usual depth is in excess of one and one-half miles, maintenance of a vertical hole is indeed a problem. The average weight carried on the bit is three points, but when the hole is found slightly off-vertical the weight carried is reduced to 1.0 to 1.5 points.

Drilling Mud. For the first 5000 to 7000 ft., mud having a weight of 10.5 lb. per gal. is used. To overcome high gas pressures, which are as high as 3200 lb., from 400 to as much as 2000 sacks of mud-weighting material is added to the mud. In well State No. 4 500 sacks of weighting material were required to overcome the high pressures.

Size Hole. Operators start with a 15-in. hole for the conductor pipe, below which the hole is reduced to 12.25 in. for the surface string. The hole below the surface string is reduced to 9⅞ inches.

Drilling Bits. From 35 to 45 bits are required to drill a well, as many as six rock bits being used on a single well.

Drill Pipe. Hole for the 24-in. conductor and 18⅝-in. surface string is drilled with 6-in. drill pipe; the rest of the hole is drilled with 4-in. drill pipe, equipped with a 40-ft. drill collar. A 40-ft. kelly is employed instead of the conventional 30-ft. kelly joint.

Casing Program. Present standard practice calls for a casing program as shown in the accompanying table.

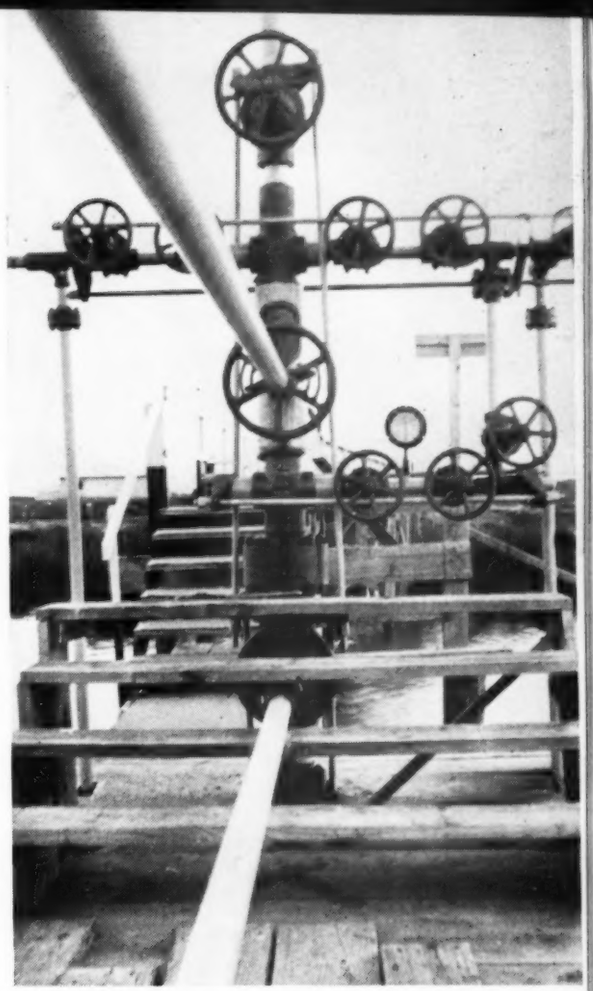
In drilling State No. 5, the deepest well in the field, the 9⅝-in. string of casing was cemented at 9160 feet. The casing program on the first well consisted of a 24-in. conductor string, an 18-in. surface string, and a 13⅜-in. protection string; however, since its completion all wells have been drilled with the casing program shown above.

Blow-out Connections. Immediately after setting the 13⅜-in. pipe, a 6000-lb. blowout preventer is installed on a 13⅜-in. O.D. flange connector. Above this is placed a 13⅜-in. outlet gate. Circulation inlets and outlets are 8-in. O.D. swedged down to 6-in. flow lines. The blow-out connections are mounted in a 6-ft. by 7-ft. by 8-ft. cemented cellar.

Water Supply. Suitable water for drilling rig requirements is obtained from a water well drilled to a depth of 765 feet. Operated by a vertical pump, this well supplies a 2-in. stream 24 hours per day for a single drilling rig. It is powered by a belt drive from gas engines having a 4½-in. stroke and a speed of 1000 revolutions per minute. The first unit pumps into a storage pit measuring 60 ft. by 82 feet. A second pumping unit (gas-operated) picks up the water from the pit and delivers it to the drilling rig through a 2-in. flow line. The water-pumping station is housed in a corrugated sheet-iron house measuring 18 ft. by 42 ft. by 11 feet.

Type	Size	Weight	Amount	Cement Used
Conductor	18⅝-in.		200 ft.	180 sacks
Surface String	13⅜-in.	51-lb.	2150 ft.	700 sacks
Protection String	9⅝-in.		6400 ft.	700 sacks
Oil String	7 -in.	28-lb.	8000 ft.	400 sacks

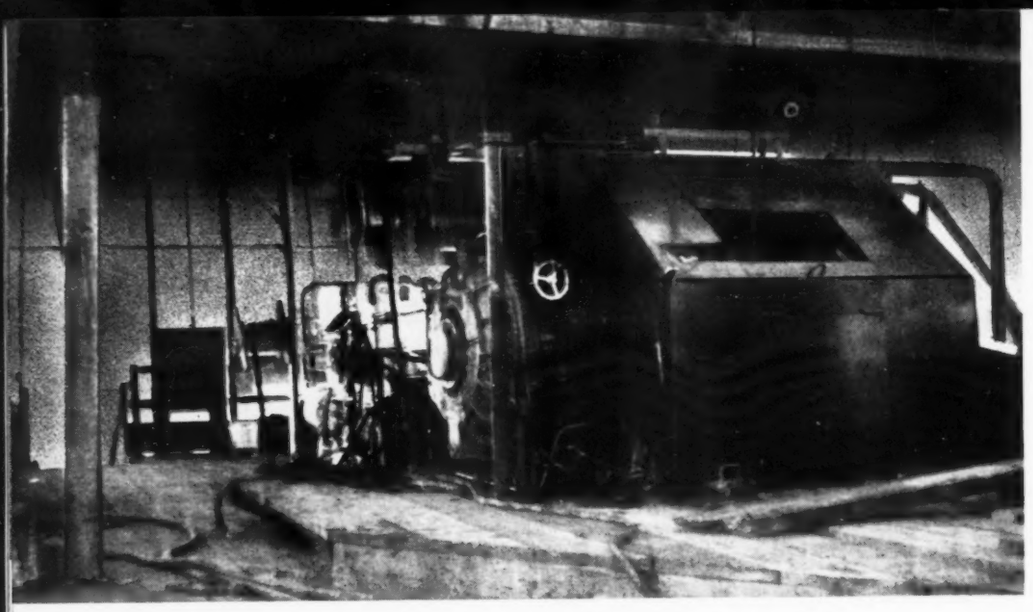
Heater in use at Stanolind's State No. 2, a gas well. The two lead lines (right top) extend to and from the gas well



Front view of Christmas tree at Stanolind's well State No. 2. When photograph was taken the pressure was 2400 lb. on the tubing and 2300 lb. on the casing

Gas Well Pressures. The pressures on one well were as high as 2450 lb. on the casing. In handling the high gas pressures through chokes, at least once on this well has freezing occurred at the well-head connections, a coating of frost 3-in. thick having formed on the connections below the choke. This well, State No. 2, has been equipped with one of the highest pressure well control installations in the country. Well pressure, varying between 2900 and 3200 lb. per sq. in., is reduced to supply gas to nearby drilling rigs at a maximum pressure of 100 lb., and to a pipe line to the Pan-American Refinery at Texas City—there is no gas waste to flares, etc.

By referring to the diagram accompanying this article, the method of



Engine and drawworks on Stanolind's well State No. 6

gas-pressure reduction and control at well State No. 2 may be followed. Gas pressure is reduced in three stages. The gas at full well pressure and at about 80 deg. fahr. is taken from the well through a heater, which uses hot water to transmit heat to the lines carrying the gas, raising the temperature of the gas to about 146 deg. fahrenheit. Upon leaving the heater, the gas passes through a high-pressure Mason-Neilan pilot-operated reducing regulator, acting as an automatic choke, and is reduced to a pressure of 750 lb., causing a drop in temperature to 46 deg. fahrenheit. The gas is then reheated, using another coil in the same heater and the temperature raised to 125 deg. fahrenheit. After leaving the heater the second time, the pressure is reduced from 750 to 180 lb., the pressure reduction causing the temperature to drop to 82 deg. fahr. using the same type regulator as in the first stage. This regulator will hold full well pressure if it is ever necessary. A thermostatic control element, which controls the gas fed to the heater, is placed in the line after the second pressure reduction. This insures the wet gas being at the most efficient temperature for separation of distillate when it reaches the 1000-lb. separator. The lines leading from the separator supply gas to nearby drilling rigs, gas engines, and also to the Pan-American Refinery at Texas City. As a safety measure, a back-pressure regulator is connected to this line set to discharge to the atmosphere in the event gas pressures go above 250 pounds.

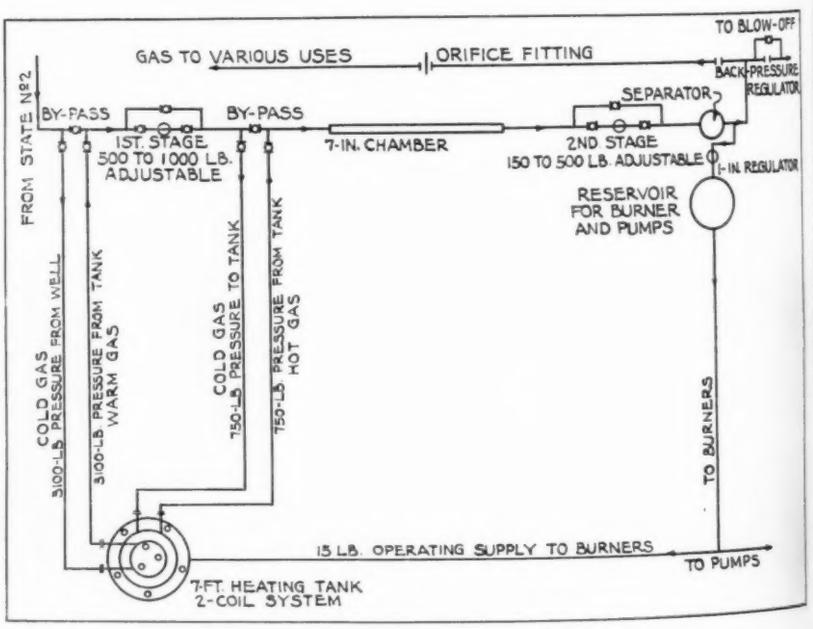
The freezing problem has been completely solved by adding the amount of heat to the gas that it loses when pressures are reduced.

Operating pressures of 225 lb. are handled by a 30-ft. by 12-ft. separator having an oil capacity of 20,000 bbl. and a gas capacity of 20 M. cu. feet. The separator has a shell thickness of 5/8-in. and is tested at the factory for 1000-lb. pressure.

WELL DATA
DICKINSON BAYOU DEVELOPMENT
DICKINSON OIL FIELD—GALVESTON COUNTY, TEXAS
STANOLIND OIL AND GAS COMPANY WELLS

Data	1 State	2 State	3 State	4 State	5 State	6 State
Conductor	24 in.	18⅝ in.	18⅝ in.	18⅝ in.	18⅝ in.	24 in.
Surface pipe	18 in.	13⅜ in.	13⅜ in.	13⅜ in.	13⅜ in.	18 in.
Protection	13¾ in.	9⅝ in.			9⅝ in.	13⅜ in.
Oil string	7 in.	7 in.	7 in.	7 in.	7 in.	7 in.
Liner	5 in.	5 in.	5 in.	5 in.	5 in.	5 in.
Screen (Emsco)	5 in.	5 in.	5.010 in.	5.010 in.	5 in.	5 in.
Tubing	2½ in.	2½ in.	2½ in.	2½ in.	2½ in	
Christmas Tree	6000 lb.	6000 lb.	6000 lb.	6000 lb.	6000 lb.	
Plug-back depth		8150 ft.	8025 ft.	8050 ft.	7980 ft.	
Total depth	8115 ft.	9000 ft.	8132 ft.	8125 ft.	9160 ft.	
Perforated section		8060-70 ft.	7997-8024 ft.			
Status	Oil well	Gas well	Oil well	Oil well	Oil well	
Init. prod.	163 12 hr. ¼ in.	3.7 M.c.f.*		314.96 bbl. 1st 24 hr.	248.72 bbl. 1st 24 hr.	
Init. pressure tubing	1500 lb.	2400 lb.	500 lb.		3000 lb.	
casing	1575 lb.	2300 lb.	500 lb.		2750 lb.	
Elev. (surface)	17 ft. D.F.					

* ¼-in. 3,700,000
3/16-in. 2,600,000
⅛-in. 1,000,000



2-stage regulator setting and heating system on high-pressure gas well, Stanolind Oil and Gas State No. 2, Dickinson field

Application of Gas Engine-Driven Generators for Protection Against Pipe Line Electrolysis

By A. H. BLACKMORE*

Units for use in remote areas where purchased power is not available attracting attention

GAS engine-driven generators have attracted considerable attention among electrolysis engineers for applications where power supply is not available. Although there are several methods of protection that effectively combat electrolytic action, the simpler problems have been approached first. Applications are now being made in remote sections where power must be generated for protection.

Electrolysis is a form of corrosion resulting in chemical decomposition by the action of an electric current. Electrolytic corrosion of underground structures may be attributed to the action of both stray currents and galvanic action; however, major corrosion problems of long transmission pipe lines do not result from stray currents because of the location of these pipe lines in open country far removed from sources of power generation.

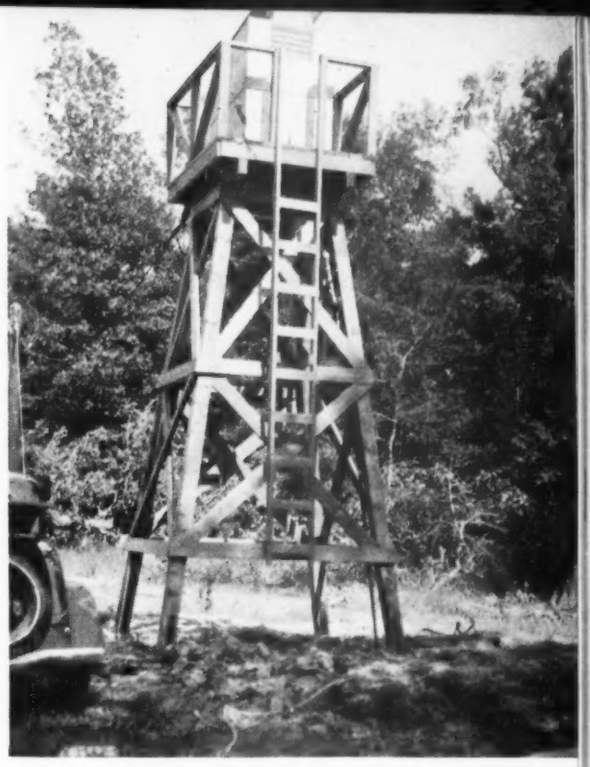
Galvanic action, or electro-chemical reaction, between pipe materials and the surrounding soil may occur when no stray currents are flowing. Soil containing salts and moisture forms an electrolyte and the presence of a metal pipe in this conductive soil permits the flow of galvanic currents due to the existing differences in electrical potential between the pipe and the soil.

As tests have corroborated this statement of theory, experience has shown that electrolysis causes metal to leave the pipe at points where the pipe potential is positive to that of the surrounding soil. Under this condition the pipe is termed anodic. The serious result of this metal removal presents itself in subsequent leaks and often in the necessity of ultimately replacing entire sections of the pipe itself.

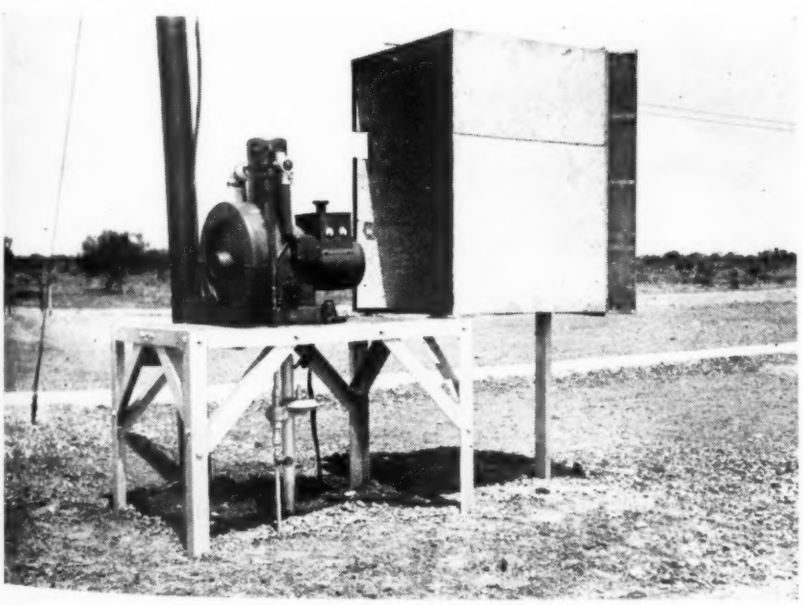
No appreciable amount of trouble occurs where the current enters the pipe, and at this point the pipe is termed cathodic or negative to the surrounding medium. This fact suggested a logical solution of electrically draining the pipe, or of maintaining the pipe at a potential lower than that of the adjacent soil so that no current could flow from the pipe into the soil. This is known as cathodic protection.

If it were possible to insulate the pipe completely from the surrounding soil, electrolysis could be prevented. At one time it was thought that protective coatings on the pipe, such as coal tar enamel, would effectively combat the deleterious action of electrolysis. However, moisture from the soil eventually will penetrate this coating at points of abrasion or imperfections, if such exist, and permit a current flow to be established. This action is cumulative, since the current flow further weakens the protective covering.

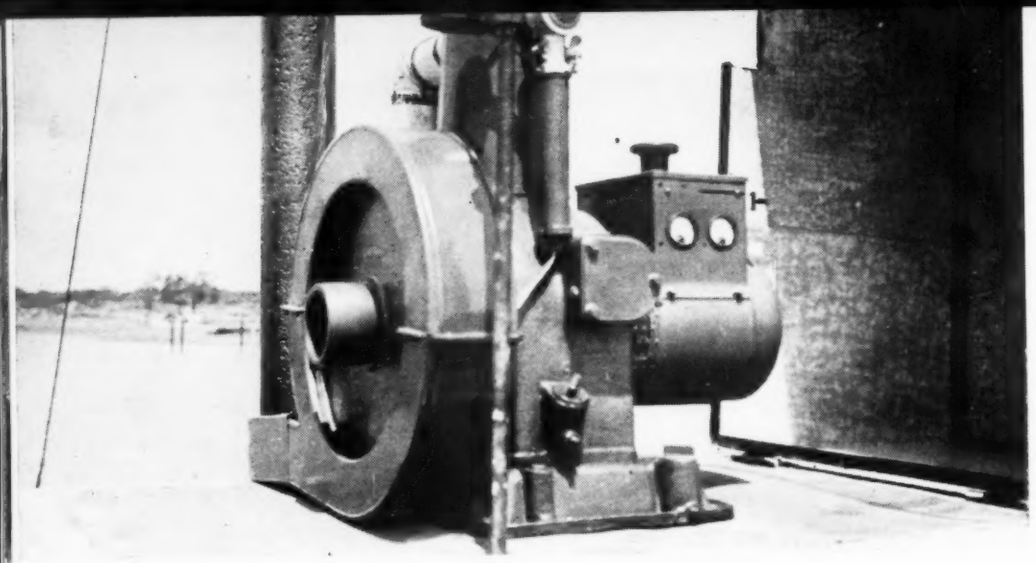
*Industrial Division, Westinghouse Electric and Manufacturing Company, Houston, Texas.



Unit mounted on 18-ft tower in territory subject to high water



View of gas engine-driven generator showing base mounting details



Close up view of unit with cover removed

The high resistance coating of the pipe has been an aid in the application of cathodic protection, as it permits the maintenance of potential difference without excessive power costs. It is seldom feasible to introduce a potential difference on a bare pipe.

Mitigation of electrolysis has been tried in various applications of an external power source of such characteristics as to make the pipe cathodic. These applications include rectification equipment and motor-generator sets where power supply is available; however, pipe line extensions of greater length and wider divergence have caused the electrolysis engineer to be confronted with cases of trouble at points distant from either generating stations or transmission lines.

Recently windmill-driven generators have been placed in operation in various sections of the Gulf Coast area; however, these applications are subject to the changes in velocity and direction of the wind. As continuity of protection has been proved to be a consideration, and as full time operation of a wind-driven device cannot be assured unless periods of over-protection are encountered, further investigation of protective devices has suggested the development of constant speed engine-driven generators.

Natural gas pipe lines have provided an interesting field of application for gas engine-driven generators because of the divergence of these lines from areas where other means of protection might be utilitized. Increasing problems are being encountered as the extensive pipe line networks pass through swamps and remote areas of high alkilinity, both of which are conducive to electrolytic action. Locations that are distant from sources of power supply usually are sections where the expense of routine maintenance is greater and cost of pipe replacement high. Further, as economy of operation of any protective device is a major consideration, the gas engine-driven generator is particularly applicable to gas pipe lines as natural gas fuel supply for the engines may be taken from the pipe lines through reducing valves.

Tests have proved that pipe lines can be protected most effectively in lengths shorter than those used in most of the first installations. For this reason the required capacity of the generating equipment is less than on some of the early experiments and may be quite compact and mobile. This makes the installation in remote areas a smaller problem and permits the location of units at points where most needed.

It has been determined that the most economical size of generator is one capable of delivering 60-80 amp. d.c. at a potential of 5 to 10 volts. With this voltage and current properly applied under favorable conditions it is possible to protect as much as five miles of pipe with one unit. The electrical requirements will vary, of course, with the soil characteristics, the condition of the pipe surface, and the type of ground bed used.

The generators of the gas engine units are applied in a manner similar to that used in the application of other protective devices. The positive terminal of the generator is connected to the ground bed through a large, low-resistance conductor, the ground bed usually being placed approximately 600 ft. from the pipe. The negative terminal is connected in much the same manner to the pipe line itself. The generator may be situated at any convenient point between the pipe and the ground bed.

The forced potential causes the current to diverge from the ground bed and seek return to the source through a path of least resistance. The pipe line, being a good conductor, affords such a path and this current flow into the pipe causes it to become cathodic. The generator current, as well as other currents caused by galvanic action, will be drained off to the ground bed.

The generator is direct-connected to the engine, the unit having only two bearings, as an endeavor has been made to obtain simplicity of construction throughout. The units are air-cooled and are arranged for four cycle operation. As protecting devices must operate for many days or even weeks at a time without supervision or maintenance, the operating speeds of the gas engines have been purposely kept low in order to assure continuity of service. The design of units already placed in service is such that they will be capable of 30-day operation without inspection.

The success of the gas engine-driven generators already installed has been quite gratifying and it is expected that an application of these units will soon be worked out so that this type of protection may be procured for oil pipe lines as well as gas lines. Although most consideration thus far has been given only to protection of pipe lines, future developments may open even broader fields of application.

Typical installation with weatherproof cover over unit. View also shows pole line for generated current

Conserving the Gravity and Volume of Crude Oil in the Field

By S. F. MAUNEY, JR.[1]

Methods, which, if employed, would result in a marked reduction in crude oil losses, are discussed by the writer

MUCH attention has been given to conservation of crude oil from the standpoint of supply and demand and the application of efficient production methods. Conservation of diminishing crude supplies by the use of secondary recovery methods also has come in for its share of publicity; but there is another form of conservation that, although discussed to some extent, has not received wide publicity nor the application of effective methods to bring it about. That is the prevention of gravity and volume losses in handling and preparing crude oil for transportation to the refineries after it has been raised to the surface.

Government agencies and many independent writers have attempted to bring the size of these losses to every one's attention, and many companies have tried by various methods to prevent or decrease them; however, the author discovered in a recent survey in Oklahoma that there exists a general lethargy in regard to these losses; that they are classed as "necessary evils", and that no particular effort is being made to prevent them.

[1]Chemical Engineer, The Carter Oil Company.

In terms of percentages, these losses do appear to be small, but when translated into dollars they assume an enormous figure. Schmidt[2] states that Wiggins in 1921 estimated the average evaporation loss in the Mid-Continent from well to refinery at 6.2 percent, and divided it as shown in Table 1.

TABLE 1

Results of 1920-21 Survey by Bureau of Mines showing average evaporation losses of crude petroleum in Mid-Continent Area.

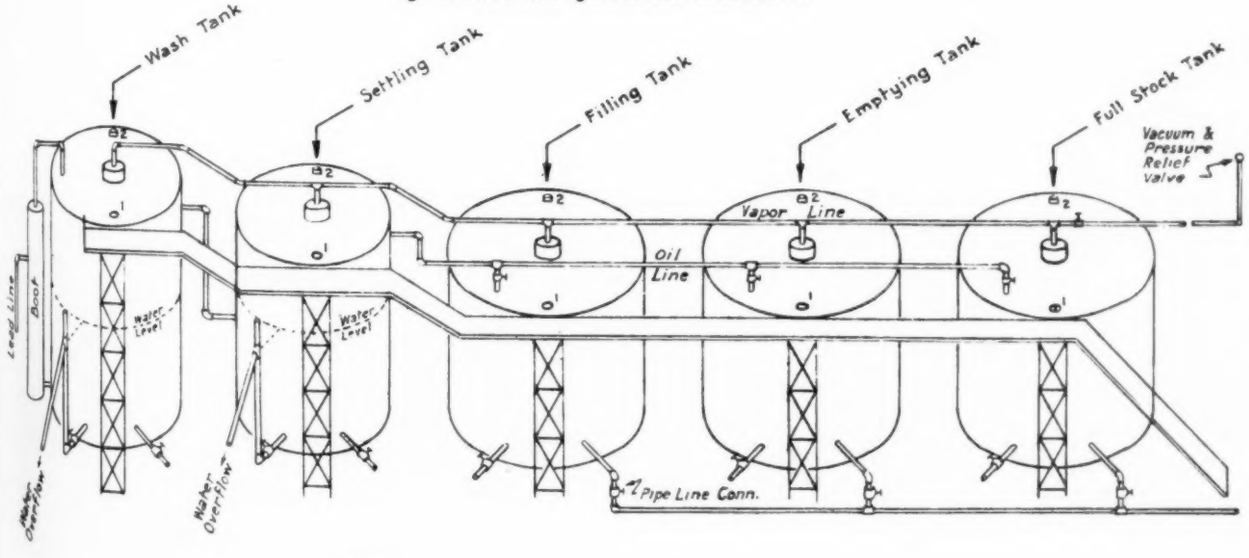
Source of Loss	*Average Pct. Evaporated*
Flow tank	1.0
Filling lease tanks	1.0
Lease storage	1.5
Gathering systems	1.0
Transportation	1.0
Tank farms	.7
TOTAL	6.2

Schmidt[2] conservatively estimates that losses from well to refinery in the Mid-Continent have been cut from 6.2 percent in 1921 to approximately two percent in 1934. The writer believes this figure entirely too small; but, applying it to the daily production in the Mid-Continent of approximately 1,800,000 bbl. there is a daily evaporation loss of 36,000 bbl., which at $1.10 per bbl., amounts to $39,200. More than 50 percent of the total evaporation loss occurs on leases where gravity affects prices. The estimated lease evaporation loss indicates about a 0.4-deg. loss in gravity, which means that possibly one-third of the total production loses 2c per bbl. in price. This amounts to a further daily loss of $12,000, or a total estimated daily loss of $51,200.

Schmidt[2] further states that lease losses could be reduced to less than one percent by using properly-maintained and efficiently-operated tankage, but only approximately 50 percent of the possible decrease in evaporation loss is realized by the operators because of poor use of the equipment provided. Recognition of these losses and the application of common-sense methods can result in enormous savings to all oil companies.

[2]"Applied Methods and Equipment for Reducing Evaporation Losses of Petroleum and Gasoline," by Ludwig Schmidt, *U.S.B.M.Bulletin 379*, 1934.

Fig. 1. Modified gasometer installation



Note:
1 - Gage hatches with vacuum relief valves
2 - Weight hatches with no vacuum relief valves

Evaporation Loss Measurements: It is necessary to utilize some method of arriving at losses that occur in handling and transporting crude. A number of methods exist that can be employed on leases, but the writer recently has made a modification of the gravity-loss method that seems to fill the bill. By this method the percent of volume loss against gravity on any crude oil is determined in the laboratory. Then the gravity of a composite sample is taken, or a number of gravity tests made on uncut fluid direct from the separator are averaged. Crudes containing emulsion or water are cold-treated in a closed container, such as a fruit jar, with excess chemical, and allowed to settle. Then the gravity of that sample, noted as cold-treated gravity, is the gravity of unprocessed oil. The average gravity of the run tickets, subtracted from the crude or unprocessed oil gravity and applied to our volume-loss-versus-gravity curve, gives, with relatively good accuracy, the volume loss that is sustained on any lease. Where evaporation losses per deg. gravity are not known for a crude the average for Mid-Continent crude can be used, which is about 2.6 percent per degree. The method can be applied in any step of the treating process on a lease by merely taking the gravity before and after that step.

With regard to losses incurred in pipe lines or while the crude is standing at gathering stations, the writer prefers the "Air Equilibrium Vapor Pressure Method", undoubtedly more accurate than any other method available. This method consists of taking a composite sample before the crude enters a storage tank or line, and then taking a composite sample of the same oil as it is discharged at the end of the line or from the tank after the desired storage period. Air equilibrium vapor pressure tests are made on the composite sample taken at the beginning, and with various percentages evaporated, to procure a curve. Then, by applying the vapor pressure of the composite sample, taken at the end of test period, to this curve, the percentage lost in transportation or in storage can be read directly.

A small pump that will take a continuous sample is preferred for obtaining composite samples; however, good results have been had by taking regular manual samples at certain time intervals over the period of the test.

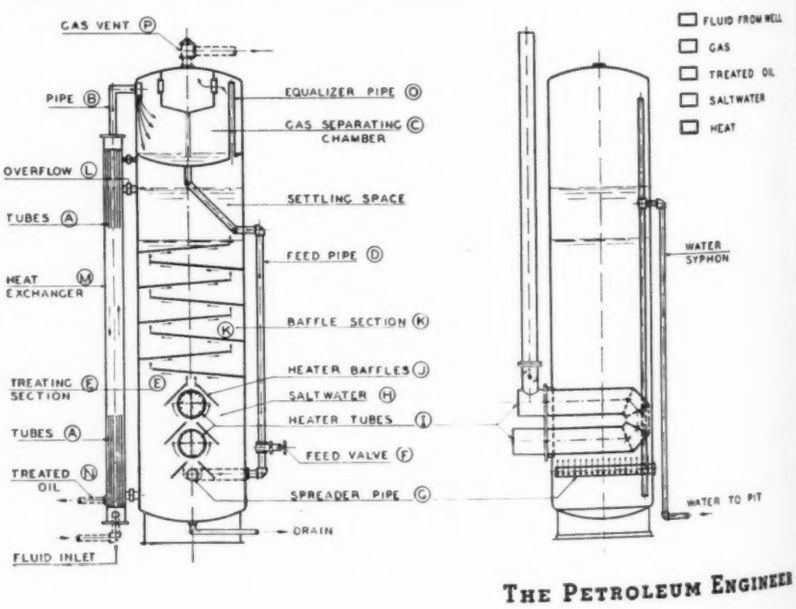


Fig. 2. Flow diagram of treating unit for crude oil

(Photo courtesy National Tank Company, Tulsa, Oklahoma)

LEASE LOSSES

Tight Tankage: The first and most important factor to consider in attaining low lease evaporation loss is tight tankage. The comparison of open versus tight tanks is best shown by the tests given by Wiggins[3] and quoted here from a recent U. S. B. M. Bulletin[2].

"The value of vapor-tight tanks alone in reducing evaporation losses is shown by the tests made in 1920 and 1921 by Wiggins[3] to determine the effectiveness of vapor-tight tanks in reducing volumetric loss and lowering of the gravity of oil by evaporation. Three tanks of various degrees of tightness were used in one test. (1) An open tank with an ordinary sheet-steel roof (without gaskets between the roof seams), equipped with an 18-in. manhole in the center, and two 8-in. gauge holes without covers. (2) A tank with a sheet-steel roof, equipped with one '4-in. vent' six ft. long, with gaskets along all seams and around the chimes and bolts spaced about three in. apart. (3) A 'small-vent tank' fitted with an automatic pressure and vacuum regulator, with a roof of heavier material than those of the other two tanks, gaskets along all seams and around the chimes, bolts about two in. apart. In the open tank the oil was allowed to splash in through the manhole, but in the other two the oil line was flanged to the top.

"The results of this test are given in Table 9. The data show that a loss of about six percent occurred during the filling of the open tank and that this loss coincides with a loss in gravity of the oil of about 2.5 deg. A.P.I. The results show also that the tighter the tank the less is the loss in volume of the oil and change in gravity. In fact, the loss in volume and change in gravity in the small vented tank were only about one-third of the corresponding losses in the open tank. Tests on these tanks while standing full show even greater savings for the vapor-tight equipment."

Schmidt[2] states that further tests have indicated that the use of welded tanks carrying 12 to 16 ounces pressure will incur only about one-third the losses resulting from tight-bolted tanks. The logical method then of handling crude oil in treaters and lease storage is by means of welded tanks. Where unusually large production is obtained or potentials are taken periodically, it is necessary to use some large bolted tanks, due to the size limitations

[3] "Methods of Decreasing Evaporation Losses of Petroleum," by J. H. Wiggins, *U.S.B.M. Tech. Paper 319*, 1923.

TABLE 9

Results of comparative evaporation tests on three lease tanks with varying degrees of tightness.

Tank	Total time days	Time actually receiving oil, days	Time not receiving oil, days	Average atmospheric temperature, °F	Quantity Evaporated Bbl.	Quantity Evaporated Average percent of vol.	Change in Gravity From °A.P.I.	Change in Gravity To °A.P.I.	Change in Gravity Loss °A.P.I.
LOSSES DURING FILLING									
"Open"	5	2	3	37	14.4	5.97	40.73	38.27	2.46
4-in. vent	5	2	3	37	6.0	2.55	40.73	39.70	1.03
Small vent	5	2	3	37	4.5	2.03	40.73	39.90	.83
LOSSES WHILE STANDING STILL									
"Open"	5	.....	.....	49.4	9.2	4.0	38.27	37.17	1.10
4-in. vent	5	.....	.....	49.4	2.8	1.26	39.70	39.37	.33
Small vent	5	.....	0	49.4	1.8	.79	39.90	39.59	.31

of welded tanks imposed by transportation regulations. A number of companies are using welded tanks, usually 210-bbl. capacity, for the regular prorated production, and have one or more large bolted tanks in the same battery for potential or flowing tests.

A great number of 55,000-bbl. tanks have been sold in the Mid-Continent in recent months, for approximately $300 to $500 each. Approximately 35 tanks of 210-bbl. capacity, 42 tanks of 150-bbl. capacity, and 52 tanks of 700-bbl. capacity can be made from a 55,000-bbl. tank in good condition. A number of tank companies will cut down the 55,000-bbl. tanks and prepare to your own specifications the welded lease tanks that are desired, at about the following prices: 100-bbl., $110; 150-bbl., $175; 210-bbl., $200. It is readily apparent that the use of these tanks, considered from the cost standpoint alone, would be desirable, without considering their long life and ease of moving, and the conservation obtained by the maintenance of pressure on the stock tanks or treaters.

On either welded or bolted tanks, the use of a modified gasometer system, as shown in Fig. 1, effects considerable saving in that the air, which is the actual thief of crude oil held at atmospheric or lower pressures, is prevented from reaching the oil to carry off its load of vapors. When the tank is emptying the gas necessary to replace the oil going out is obtained from an adjoining tank that is filling, or from the gases that rise from the oil in the treater. This system necessitates, of course, the use of vapor-tight hatches, and it is the writer's opinion that the vent line should carry slightly lower pressure than the tanks so that the tank valves will operate only under unusual load condition or in emergencies. The writer prefers the use of a liquid seal valve that is independent of the hatches, and, as second choice, a mechanical deadweight vacuum and pressure-relief type of valve that is incorporated in the hatch. Better success has been obtained on this second type valve by using a metal-to-metal seat.

A number of other things assist in procuring the best results with tight tankage, among which are the use of "cool" colors in painting the tanks, and the use of tank sizes best adapted to the volume of production so as to prevent long periods of storage.

Treating Cut Oil: This phase of handling crude on leases has been as badly neglected as has the condition and tightness of lease tanks. Whenever possible the formation of emulsion should be prevented by conditioning the well equipment. Well equipment often is used when in poor condition and the resulting emulsions treated above ground, usually with considerable economic loss, because the proper authorities are not notified of this condition. In many instances, where mechanical changes do not prevent the emulsion, "down-the-hole treatment" may prevent the formation of the emulsion or resolve the emulsion before it reaches the surface. This possibility always should be considered before extensive treating plants are built on a lease.

The use of tight tankage in conventional types of direct or indirect "Chemical and Heat" treating plants is just as essential as it is in the stock tanks. Generally it is better to use welded types so pressures can be maintained and the gas that is evolved can, by means of the gasometer system, blanket the oil contained in the stock tanks.

Field men generally believe it is better to use a high treating temperature and a very small amount of chemical, since usually there is available a supply of gas free of cost or at least at very low cost. Of course, they could hardly be blamed for following that method, since the old form of treating reports merely shows the cost of chemicals applied and does not take into consideration any measure of the losses incurred. The losses can and should be evaluated by some method, such as, the gravity-loss method given above and recorded on the treating reports. Examples of the savings that can be obtained by decreasing treating temperature are given in Table 2 and Table 3.

It is important in the conventional type of treaters to use a "boot" (conductor) to introduce the cut oil into the bottom of the "wash" tank and the inside type is preferred, especially in fields with low concentration salt water, which is subject to freezing. The inside type also permits the use of a perforated cone bottom that spreads out the oil over a larger area.

The correct introduction of the chemical has a considerable influence upon the success of treating. It is important to introduce the treating chemical as far from the treater as possible in order to insure complete mixing. The use of chemical proportioning pumps, situated at each well, and actuated by the pumping mechanism, performs this introduction satisfactorily but the problem of introducing the chemical at flowing wells has not been solved completely. There is a relatively inexpensive but unproven proportioning pump on the market that is actuated by a liquid motor, whose rotational speed is governed by the volume of oil passing to the treater, thereby delivering the chemical in proportion to the volume of crude flowing through the line. One company has made use of the gas pressure always

TABLE 2

Effect of treating temperature. Lease "CE", Oklahoma City Field (Conventional direct wash type with bolted tanks)

Days of Test	Treating Temps.	Chemical Costs $ per bbl.	Gas Costs	Average Gravity From Run Tickets	Average B S & W Percent	Average Price Received $ per bbl.	Volume Saved Percent
15	165°F	.0069	Free to Lease	37.9	0.2	1.12	0
15	135°F	.0103	Free to Lease	38.1	0.2	1.14	0.5

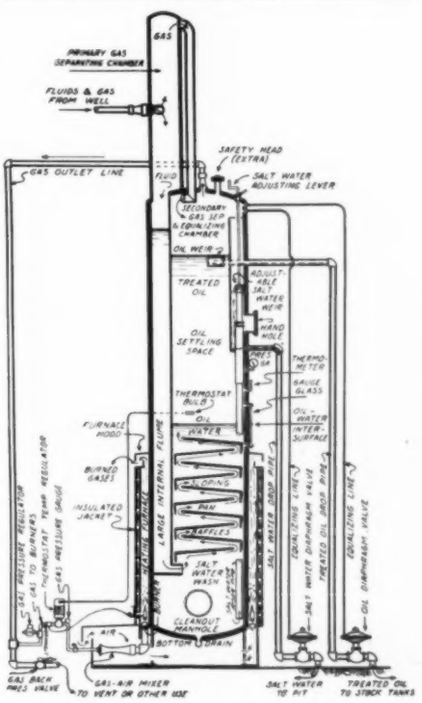


Fig. 3. Section through automatic flow treater with big shell heater

(Photo courtesy Black, Sivalls and Bryson, Oklahoma, City)

TABLE 3
Effect of treating temperature, Seminole Field (Conventional types with bolted tanks)

Lease	30-DAY RECORD PREVIOUS TO DECREASING TEMP. Approx. Bbl. Per Mo.	Treat. Temp.	Chemical Cost/Bbl.—$	Grav.	30-DAY RECORD AFTER DECREASING TEMPERATURE Temp. Change	Treat. Temp.	Chemical Cost/Bbl.—$	Grav.	RESULTS OF CHANGE Chem. Cost Chgd./BBl.—$	Increase In Grav.	Est. Vol. Increase—%	Gain/Bbl. For Grav.—$	Total Gain Per Bbl.—$
M. K.	4,119	130°	.004	39.6	6-10-36	A***	.007	40.0	.003	.4	1.04	.02	.029
G. K.	1,383	130	.018	37.4	5-26-36	A"	.018	37.9	.000	.5	1.30	.00	.014
M. K.	31,252	155	.003	37.8	6- 6-36	A"	.002	40.8	—.001	3.0	7.80	.07	.144
T. L.	5,681	120	.006	38.5	6- 4-36	A"	.005	38.9	—.001	.4	1.04	.00	.012
C.-1 M.	3,732	130	.005	37.6	6-26-36	A"	.010	38.2	.005	.6	1.56	.02	.033
C.-1 S.	5,067	130	.008	36.7	6-26-36	A"	.005	38.6	—.003	1.9	4.94	.04	.099
C.-1 S.	4,137	130	.008	37.7	6-26-36	A"	.004	38.2	—.004	.5	1.30	.02	.038
C.-1 I. T.	5,303	130	.004	37.0	6-26-36	A"	.008	37.1	.004	.1	.26	.00	—.001

available at a flowing well to actuate a small double-action steam pump to introduce chemical against pressure. The usual type of lever-operated chemical proportioning pump is operated by one rocker arm of the pump, the other operating a lubricator for the power cylinder. This pump will run on approximately eight lb. gas pressure, but it can deliver chemical only at a constant rate. The use of electrical or gas-turbine-driven chemical pumps has the same fault as mentioned for the small converted steam pump, namely, a constant rate of introduction regardless of volume passing to the treater.

The old-style lubricator has proved very erratic for introducing chemical and should not be used. It appears there is still a big demand for a successful type of inexpensive chemical pump to introduce treating chemicals into lines from flowing wells.

The use of heat exchangers to remove the heat from crude leaving "flow tanks" or "settling tanks" offers a means of reducing loss of gravity and volume in the conventional type of heat- and chemical-treating systems.

Pressure Treaters: A new device for treating with heat and chemicals has been instrumental in effecting cheap treating costs and at the same time a material saving in gravity and volume. This is the so-called pressure treater, or as is preferred by the manufacturers, "Pressure Separators." Three manufacturers have these on the market and they all operate on the same principle; namely, a separation of gas at the top and then conducting the crude containing emulsion to the bottom of the tank, allowing it to wash up through hot salt water, which, with the chemical, tends to break the emulsion. The salt water is taken off at the bottom and the crude at the top. The crude passes through a heat exchanger to give up its heat to the incoming cut oil. The operations are all carried out in one tank and can be accomplished at atmospheric pressure or lower as desired. This form of apparatus not only keeps evaporation to a minimum but accomplishes the treating in a compact unit; offers the possibility of taking off vapor to a gasoline plant; and actually costs less than conventional chemical-treating systems where new material must be purchased. Two types are shown in Figs. 2 and 3.

Draw-down of Bottoms: Another place where considerable good oil is wasted and burned is in "bottom draw-down" and cleaning of lease tanks. The necessity for cleaning of battery tanks and drawing down bottoms can be minimized by correct treating. When it is necessary to clean tanks or draw-down bottoms, this can be facilitated by using cone-bottom welded tanks, which permit the bottoms to be drawn without good oil breaking through. The "bottoms" always should be sent back through the treater, but it is best to save them until a tankful is collected and then return bottoms alone so that the type and amount of chemicals best suited for their treating can be used. Some companies equip each lease for re-circulation of bottoms, whereas others use portable pumps powered by gasoline engines that are sent periodically to each lease to clean the tanks and circulate the bottoms through the treater.

Vapor-Saving Education: Even though tight tankage and efficient treating plants be installed, there still remains a job to be accomplished before the lease losses are minimized, and that is selling the idea to the operators. The extent of the losses and the manner in which they occur; and the methods of preventing or minimizing them must be "put over" to the men. As an example, the writer often has found hatches open when tanks were "on line." The gauger's usual response was that the pumper required the hatches to be open to prevent the tanks from being "sucked in." Concerning the same hatches, the pumper usually said that the gauger required them to be open so the oil would not be hindered in running out. Both disclaimed responsibility and probably neither saw any benefit in keeping the hatches closed.

In this connection, the use of an experienced full-time engineer in each division or district as a combination treating expert and inspector will pay dividends. It should be his duty to advise on the best method of treating, types of plants and tanks, to sell conservation to the men, and to report to the operating foreman practices that result in loss of gravity and volume.

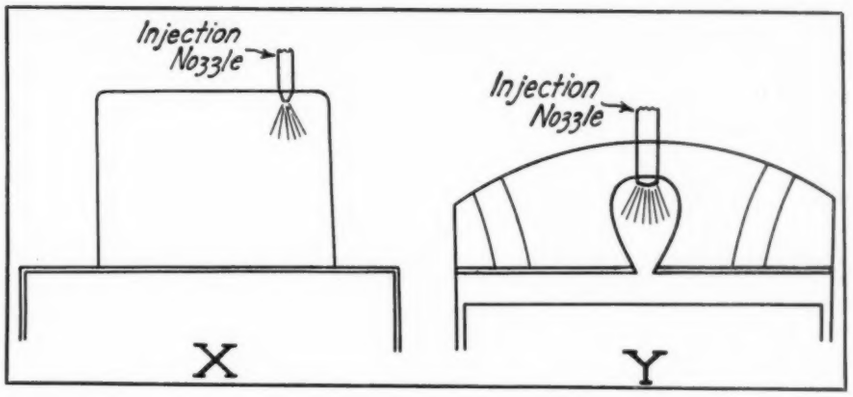
Pipe Line Losses: The pipe lines are generally concerned only with volume losses. Open hatches on a tank that is "on the line" cause a considerable loss, since the air reaches the crude and carries out its load of vapors. This being true, pipe lines should be in favor of vapor-tight tankage equipped with a gasometer system and correctly operating venting valves.

Probably the largest loss occurring to pipe lines is caused by the air entering the gathering lines through connections of battery tanks in which all the oil has gone out. This air, carrying its load of vapors, is sucked to the stations by their suction pumps and pops off at the pump or passes up through the oil in the gathering station tanks. This condition can be prevented by the gauger making a "shut-off" before the tank is out, which is usually impracticable, or by the use of an automatic "shut-off" valve. It seems that reliable shut-off valves for this use have only been available for a relatively short time.

The filling and breathing losses incurred at gathering and main line stations can be cut to a minimum by using floating-roof tanks and up-to-date pipe lines have generally adopted these.

A batch of crude of 41.3 gravity was followed by the "Air Equilibrium Vapor Pressure and Composite Sample Method" mentioned above, through a whole pipe line system equipped with floating-roof tanks, and showed 0.122 percent loss, and the same batch passing through the cone-roof tanks at the receiving station of another pipe line showed .093 percent loss. It is interesting to note that the equilibrium condition loss based on filling a cone-roof tank with this batch at the average temperature that existed was 0.129 percent.

Fig. 1. Types of combustion chamber



By
ORVILLE ADAMS

How Combustion is Accomplished in the Diesel Engine

Fuel Injection and Combustion Systems in Diesel Engines

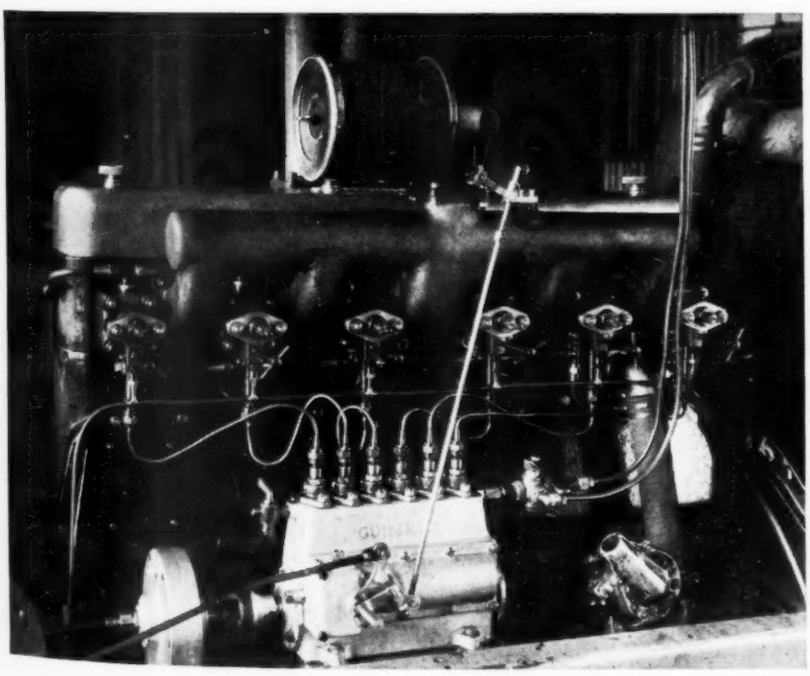
THE Diesel engine differs from the gasoline engine in that the fuel in the former must be intimately mixed with the combustion air in the cylinder in a short interval of time, whereas in the case of the gas engine the time necessary for the entire suction stroke and compression stroke is available for the fuel-mixing process. Gasoline fuel mixes easily with the intake air, due to its high velocity through the intake and its high rate of travel through the tube of the carburetor, the heated induction passages, and the heated valve port. It also is in contact with the heated walls of the cylinder during the compression stroke. This, added to the turbulence of the compression stroke, aids in completely vaporizing and preparing the fuel for rapid ignition by the spark. In other words, this mixing process in the gasoline engine goes on over 360 deg. of the crank angle, but in the Diesel engine the injection and mixture must take place during the movement of the crank through only 30 to 15 deg., consequently there is but 1/12 to 1/24 as much time available for the mixing and preparation of the fuel for combustion in the Diesel engine as is available for the same process in the gasoline engine.

Fuel injection methods, the systems employed to atomize and prepare the Diesel fuel for combustion during this short interval of time, particularly in the high-speed engines, must be highly perfected and extremely efficient. The design must be suited to the type of engine and its service if the fuel is to be properly injected, finely divided, and mixed intimately with the correct amount of air to insure rapid and complete combustion.

Diesel fuel injection systems inject the fuel at high pressure through spray nozzles into the compressed air in the cylinder. Thus the fuel becomes thoroughly atomized, or divided into very fine particles. The combustion chamber must be of such shape that the incoming air will be given a high degree of turbulence before the fuel injection occurs. This requirement has resulted in the development of numerous designs of combustion chambers, and a vast number of arrangements of the combustion space and fuel injection devices. It would be practically impossible to understand the Diesel engine without taking these into careful consideration. Success in the selection, installation, application, and operation of the Diesel requires a general knowledge of the various methods employed for the injection of fuel, and its combustion.

Classification of Combustion Systems

Throughout the history of the Diesel, particularly the last few years, during which the high-speed engine has been brought to a high degree of de-



Diesel engine with pre-combustion system of fuel injection employing individual fuel pumps and side injection of the fuel, and flat top piston. Uncontrolled turbulence is induced in addition to pre-combustion chamber turbulence

velopment, numerous systems have been developed or proposed for fuel injection and combustion. These systems fall into four or five general classes, any one of which may have certain features in common with others but still will have a certain classification according to the method employed to meet a definite operating condition and increase the efficiency of the engine. These basic classifications predetermine the variations in engine construction, and hence suggest the application to which the engine is best adapted. Obviously the various modifications of the basic systems are multiplied further by differences in opinion regarding such of these features as the systems may have in common; namely, the disposition and location of the valves, the allotment of space in the combustion chamber, design of injection valve and its position with respect to the combustion chamber, means of metering the fuel, injection pressures employed, and other features according to the fancy of the designer.

These various features are likely to be confusing to the practical operating man unless he has learned to recognize the distinctions that definitely place a fuel system in a designated class, and is able to see the relative importance of the various features of any system he is considering. The main classifications or distinctions may be described briefly as follows:

1. Open Combustion Chamber. Multiple-hole spray nozzles requiring very high injection pressures are employed to atomize the fuel.

2. Pre-Combustion Chamber System. A single-hole spray nozzle is used with moderately high injection pressure.

3. Open Chamber with Directed Air Turbulence. Most of these are distinguished by a unidirectional air-flow across the fuel spray, which may be injected at moderately low-injection pressures through fairly coarse single-hole injection nozzles.

4. Air Storage or Air Cell Chamber. Fairly low pressure is employed for injection of the fuel.

5. Low-Compression Spark-Ignition Fuel Injection. Employs fairly low pressures and divided combustion chamber. In this system the air is compressed into an air storage chamber situated either in the cylinder head or the piston.

Without going too far into the relative merits of the different designs, a brief analysis indicates that the open combustion chamber, sometimes called the single combustion method, would seem to afford the most efficient solution to combustion and heat control problems. This system provides for the highest mean effective pressures and is adaptable to small and large engines, rendering them easier to start; but the system has not been widely used in certain high-speed applications.

In the open combustion chamber the cooled surface exposed to the combustion flame is a minimum and hence

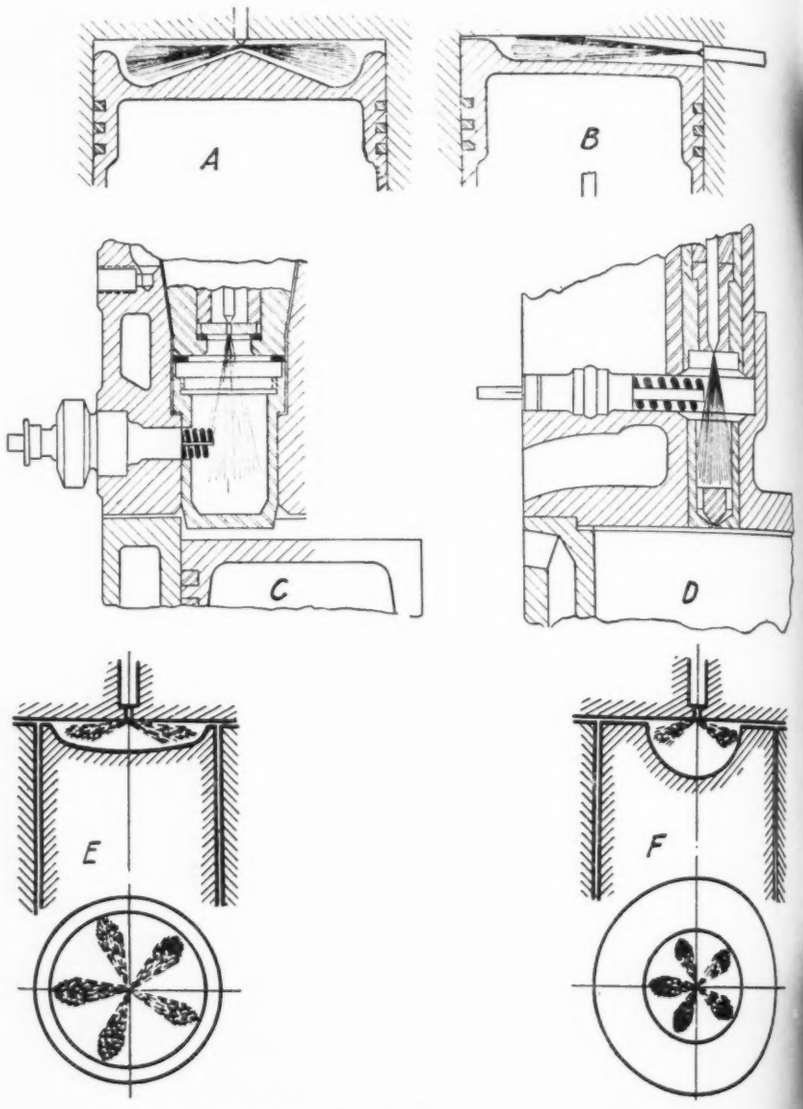


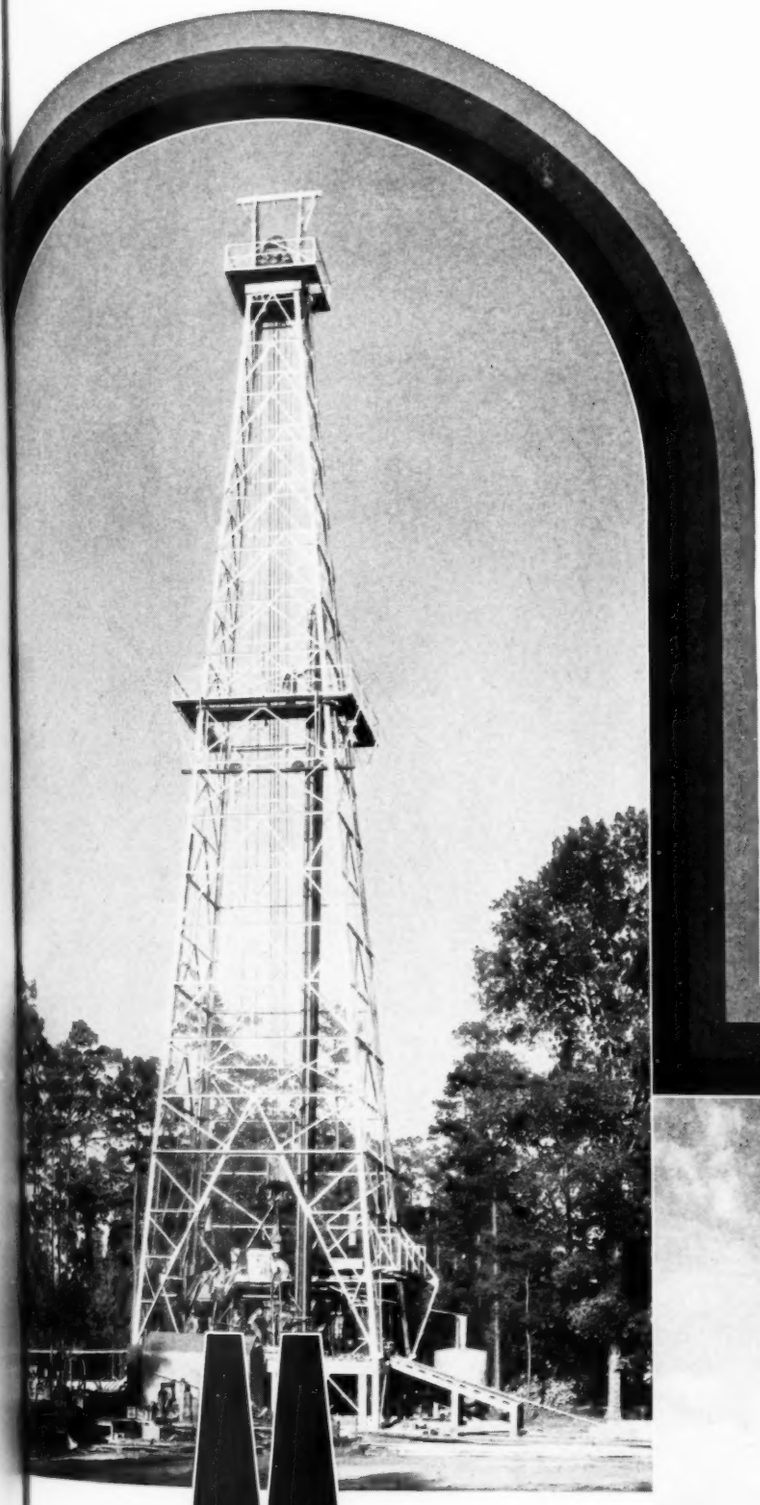
Fig. 2. Fuel injection and combustion systems

CLASSIFICATION CHART
Fuel Injection and Combustion Systems

Method	Diagrams					
	A	B	C	D	E	F
Single Chamber	✓	✓			✓	✓
Pre-Combustion Chamber			✓	✓		
Turbulence Type	✓	✓			✓	✓
Non-Turbulence[a] Type			✓	✓		
Side Injection		✓	✓			
Central Injection	✓			✓	✓	✓
Single Orifice		✓	✓	✓		
Multiple Orifice	✓				✓	✓

[a] Uncontrolled Turbulence

Dependable . . . on the toughest jobs. Where nothing can be left to chance. Intelligent engineering plus sturdy construction have made the Moore derrick the standard of the oil fields . . . . Experienced field men and stocks of parts near you, complete a valuable service.



LEE C. MOORE & CO., Inc.
PITTSBURGH · TULSA

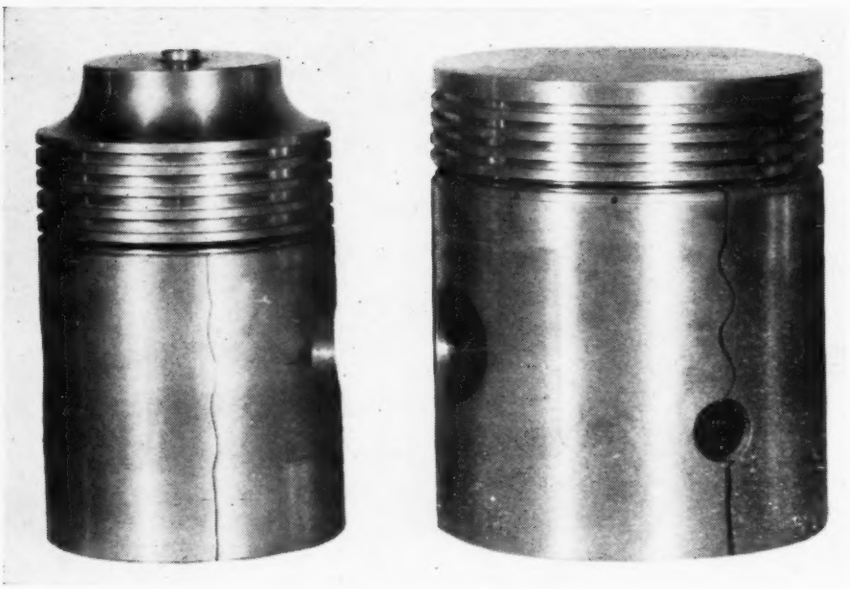
Member Steel Derrick Manufacturers Association

Corpus Christi ... Dallas ... Houston ... Henderson ... Kilgore ... Longview ... Midland ... Odessa ... Pampa ... Wichita Falls, Texas ... Chase ... McPherson .. Russell .. Wichita, Kansas .. Stocks in all active fields

•

The rugged reliability of Moore derricks has been proved at the deep test well at Abbeville, Vermilion Parish, Louisiana (righ.) and the deep test well in Webster Parish, Louisiana (left). The derricks shown are 136′ high with 30′ base and have 800,000# safe working capacity.

DERRICKS
PUMPING EQUIPMENT
Moore



Displacer-type piston and flat top piston. The former will induce a type of uncontrolled turbulence by causing a rapid displacement of the compressed air at the end of the compression stroke, thus aiding and improving combustion by intimate mixture of air with fuel

there is less radiation of heat to the cooling water; but despite its drawbacks it is the most efficient system.

The pre-combustion chamber has a larger cooled surface, resulting in greater heat radiation during combustion and compression. Rapid flow of heat from the combustion flame to the cooling water is further increased, due to concentration of the heat in the small throat or neck communicating with the cylinder, and due to the high velocity and temperature of the gas mixture that is projected into the cylinder for the second phase of the combustion. This feature alone restricts to a considerable extent the efficiency of heat utilization and the mean effective pressures in the small cylinders. The mean effective pressure of the pre-combustion chamber system is reduced further by less efficient scavenging and lower volumetric efficiency, due to a certain amount of inert gases that always are trapped in the pre-combustion chamber; moreover, the cylinder head is more complicated and heavier in this type, particularly in the case of the 4-cycle engine. Starting the engine from "stone-cold" is more difficult. Usually a higher compression is maintained to facilitate starting, aided further by heating coils or some other device. The advantages are obvious. Such an engine is not sensitive to the burning of heavier, common fuel oils, and it does not require high injection pressures through multiple orifices. The injection pump and nozzles likely will give less trouble, and require less maintenance; however, a majority of the current engines are modifications of the pre-combustion system of fuel injection, a system that had its beginning even earlier than the Diesel engine in the hot-bulb or surface-ignition type engine.

Economical operation in the field is aimed at in each system according to the views of the designer and his experience. In order to maintain the economic advantages of the Diesel engine several very practical considerations are involved. It is proper at this point to check these considerations and the factors desirable against a correlated analysis of the adaptability of the various systems to field operating requirements. Highly to be desired and demanded of any system, are:

1. Minimum fuel system maintenance that at the same time will assure the maximum reliability obtainable. Such a requirement is assured by the use of a single-hole orifice connected to a single-plunger fuel pump for each cylinder; also simplicity in the construction of each is desirable.

2. Colorless exhaust at all operating speeds and loads. This is better obtained by sustained pressure fuel atomization and is made possible by positively controlling the beginning of the injection and a sharp cut-off of the fuel at the end of the injection period.

3. Individual measuring type of fuel pumps are necessary for close regulation of the minute fuel quantities in order to assure accurate distribution to the cylinders for satisfactory idling and slow-speed operation.

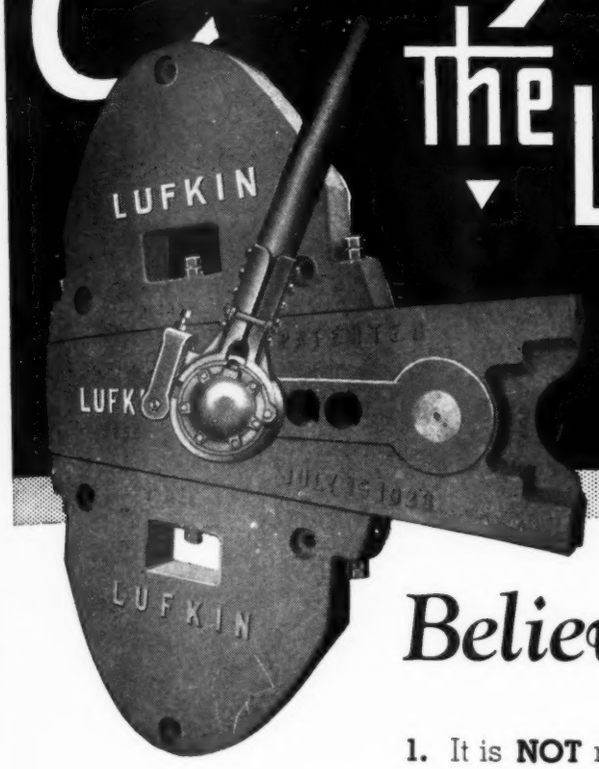
4. Rapid transformation of the injected fuel into heat by good distribution. These are best attained by correctly controlled or directed air turbulence and high-ignition temperatures at all times for the ignition of the fuel at load or at no load.

5. Reasonably low maximum pressures in the combustion chamber, attainable by limited acceleration rates of pressure rise.

For the sake of brevity and clarity in continuing the comparison of the two major kinds of combustion chamber shapes that aim at the attainment of the results enumerated, the two types in Fig. 1 can be studied. These two types are designed for the control of the combustion in the manner and for the purpose indicated, but differ radically in shape and design. Chamber *X* regulates the rate of fuel feed, and chamber *Y* has a pre-combustion chamber, or an ante-chamber, of limited capacity for air. It should be understood that the quality of combustion can be made all that is desired in either case, but chamber *X* gives a lower fuel consumption and a higher brake mean effective pressure, whereas chamber *Y* gives a greater degree of smoothness in combustion and permits high sustained brake mean effective pressures. Then, why the difference?

Fuel consumption is always a point for weighty consideration. Its quantitative value is too frequently emphasized instead of its qualitative value. The shape of the fuel consumption curve has a greater index of valuation and is of greater significance to the operating man than the actual minimum figure of fuel consumption obtained at certain loads and conditions. A close approach to the flat parabolic form of curve is highly desirable, whereas in practice it frequently is the case that the hyperbolic form of curve is found. The reasons for this should be obvious without going into calculus. In other words, the Diesel engine, if it is to be highly successful, should not have high fuel consumption at light loads and idling speeds, which will be the case unless the fuel injection and combustion system is adapted to the application and the design of the engine. Combustion chamber *X* is lower in fuel consumption simply because it will have lower heat losses than chamber *Y*, particularly at lower

Compare the LUFKIN-TROUT CRANK



Believe It or Not! . . .

(With Apologies to Ripley)

1. It is **NOT** necessary to send a truck to the tool house, or supply store, for extra weights if crank pin is set out one hole.
2. Two men are **NOT** required to put on or take off weights, when well conditions change.
3. Thirty minutes to one hour is **NOT** required to change counterbalance. (Only five minutes with a Lufkin-Trout crank!)
4. It is **NOT** hazardous to workmen to increase, or decrease, counterbalance on a Lufkin-Trout crank.
5. Lufkin-Trout cranks do **NOT** consist of a dozen or more parts.
6. There is **NOT** excessive crank shaft bearing strains due to a long radius of gyration.

The new Lufkin No. 37 Catalog is now on the press. Write today for your copy!

"LUFKIN UNITS ARE MANUFACTURED AT LUFKIN, TEXAS BY LUFKIN FOUNDRY & MACHINE COMPANY, QUALITY MACHINERY SINCE 1900."

loads and idling speeds, because it has a compact combustion chamber with less surface exposed. Chamber *Y* has greater smoothness of combustion than chamber *X*, and, therefore, will permit a higher sustained brake mean effective pressure, so that in practice the two types of chambers about balance in output.

This matter of combustion smoothness is of great importance also if it can be obtained by simple automatic means. Volume control of the burning gases, accomplished by chamber *Y*, has a more practical appeal in field operating conditions than has the fuel volume control in chamber *X*. In this connection, then, it is evident that a practical compromise must be made between low-fuel consumption and smoothness of operation, between brake mean effective pressure and low maintenance cost, between ideal full-load operating economy and wide flexibility of speed with fair fuel economy at all speeds.

Good idling is essential in applications such as those in mobile equipment. In such applications all cylinders should be able to contribute equally in providing part of the load for uniform idling, even for extended periods. An engine with the *Y*-type chamber will idle to lower speeds with positive ignition than will one with the X-type chamber. Ignition of the preliminary fuel charge is the same regardless of the load or speed with the *Y*-type chamber, the fuel consumption and thermal conditions remaining practically constant over the entire range.

Starting is easier, however, with compact chambers of the *X* type, as the more concentrated and less divided the combustion space is the lower will be the compression pressures necessary for starting the engine cold. System *X* therefore has superior starting characteristics compared with *Y*, the latter usually requiring electric heating coils to assist in starting in cold weather.

Features of the Open Chamber

With the open chamber, the shape is adapted to the shape of the spray jets and the air intake valves and ports are arranged to promote directed air turbulence. The piston is frequently so shaped as to cause additional air whirl near the top center as the piston comes up on compression, causing the whole body of rotating and whirling air to be penetrated by the fuel jet. This is to avoid the use of high-pressure high-injection pressure and multiple fine-spray orifices, which would have to be so small and numerous and also the pump injection pressure so great that the maintenance of the system would be too high even if the operation were reliable. The directed air turbulence is depended upon to produce high mean effective pressures and low fuel consumption by atomizing the fuel properly and preparing it for ignition. Uncontrolled turbulence is developed in certain types of single-combustion chambers by the shape of the piston crown, which traps air between the top of the piston and the cylinder head on the suction stroke. This may be done also by a displacer-type piston, or a wide rim of a dished piston head. There are many modifications of the idea. It may be assumed, then, that directed air turbulence in open chambers, or the use of pre-combustion chambers in combination with various fuel-injection nozzles, will be found common to the average engine in the high-speed field. The nozzles for injection of the fuel are either centrally placed in the top of the cylinder, or placed at the side of the cylinder head, depending upon the shape of the combustion chamber.

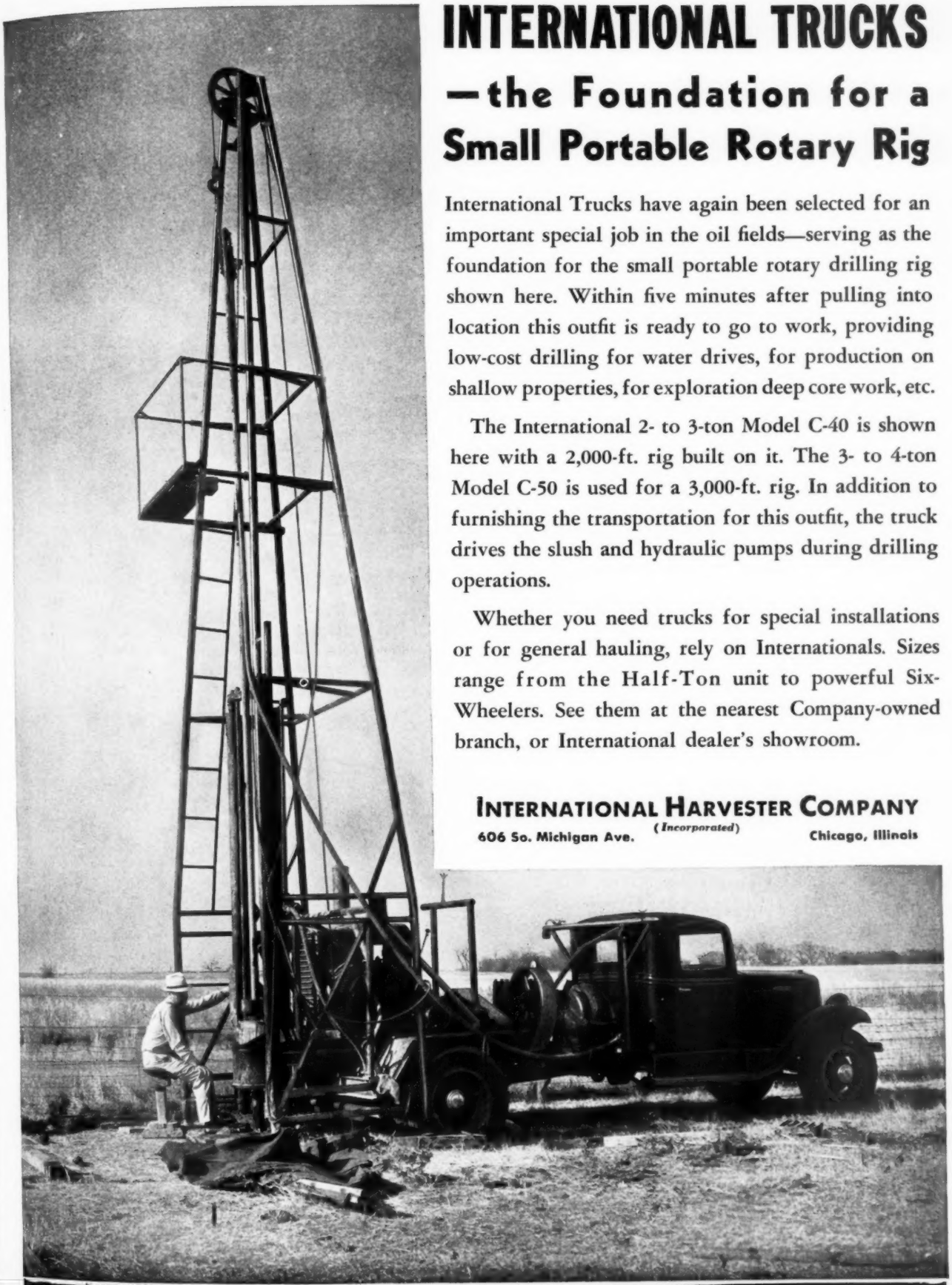
The entire theory of the Diesel engine and the history of its development being involved in this discussion, it is not the purpose here to go into intimate detail concerning all features. The illustrations in Fig. 2 are given in the hope that it will induce individual research by those interested in the further study of this subject. In the tabulation presented with Fig. 2 the features of the various systems are checked. This tabulation may be employed for the study and checking of any engine combustion system as a basis of complete analysis. The common rail system of fuel injection, for example, may be used for the various combustion chambers shown. On the other hand, an individual pump for each cylinder may be, and usually is, employed in the high-speed Diesel engine field. Exception to this is the use of a single pump plunger and a distributor disc, functioning similarly to the distributor on the ignition system of the gasoline engine. The shape, size, function, location, and design of the combustion chamber, in conjunction with a predetermined fuel injection process, has occupied the attention of designers and inventors for 30 years. The U. S. patent office has issued patents on more than 1000 modifications of the Diesel combustion chamber, and it frequently appears that a greater number are in use than is justified. To the practical man it can be said here that despite this great number of patents and designs they are only variations of a few basic types here described and discussed. It is encouraging to know that only a small number are in practical every-day commercial use. Superior systems or new arrangements of basic systems may appear at any time and offer improvements that will merit careful consideration.

No phase of the Diesel engine deserves more careful understanding on the part of the practical man and the student than that of the combustion chamber systems and the methods of fuel injection with reference to their adaptability to field service and operating conditions.

Computing Cost of Dehydrating Crude Oil

THE usual method of quoting dehydration costs is in cents per barrel, but this procedure can be very misleading unless properly applied. For example, in a recent discussion of treating costs a producer cited the figure of one cent per barrel as the cost of treating the production of a certain lease. Further investigation, however, brought out the fact that less than one-half of the oil produced on this lease required dehydration, the major portion of the production meeting pipe line requirements without being treated.

In this instance the producer had divided the total monthly cost of treating on this lease by the entire monthly production of the lease, and in this manner had arrived at the above-named figure of one cent per barrel as his treating cost. In view of the fact that the treating cost properly is chargeable only to the oil actually treated, the true cost in this instance was more than twice as much per barrel as had been estimated. This mistake is not uncommon, particularly in instances where wet and clean production is combined before treatment.



INTERNATIONAL TRUCKS
—the Foundation for a Small Portable Rotary Rig

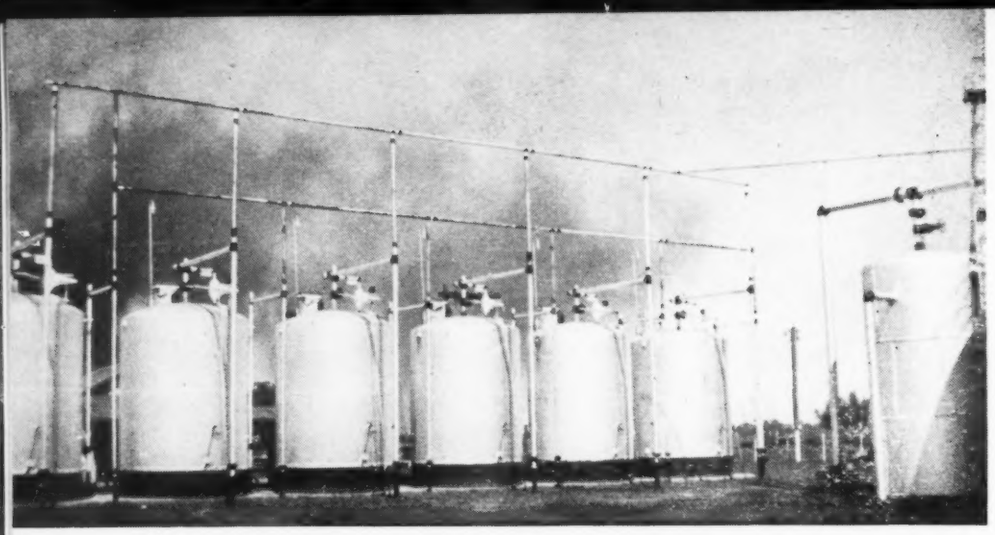
International Trucks have again been selected for an important special job in the oil fields—serving as the foundation for the small portable rotary drilling rig shown here. Within five minutes after pulling into location this outfit is ready to go to work, providing low-cost drilling for water drives, for production on shallow properties, for exploration deep core work, etc.

The International 2- to 3-ton Model C-40 is shown here with a 2,000-ft. rig built on it. The 3- to 4-ton Model C-50 is used for a 3,000-ft. rig. In addition to furnishing the transportation for this outfit, the truck drives the slush and hydraulic pumps during drilling operations.

Whether you need trucks for special installations or for general hauling, rely on Internationals. Sizes range from the Half-Ton unit to powerful Six-Wheelers. See them at the nearest Company-owned branch, or International dealer's showroom.

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. (*Incorporated*) Chicago, Illinois

INTERNATIONAL TRUCKS



View of battery of electric dehydrators showing piping connections

Difficulties overcome by installation of specially-designed heat exchangers

Closed Indirect Heating Plant Solves Oil Emulsion Treating Problem in Luling Field

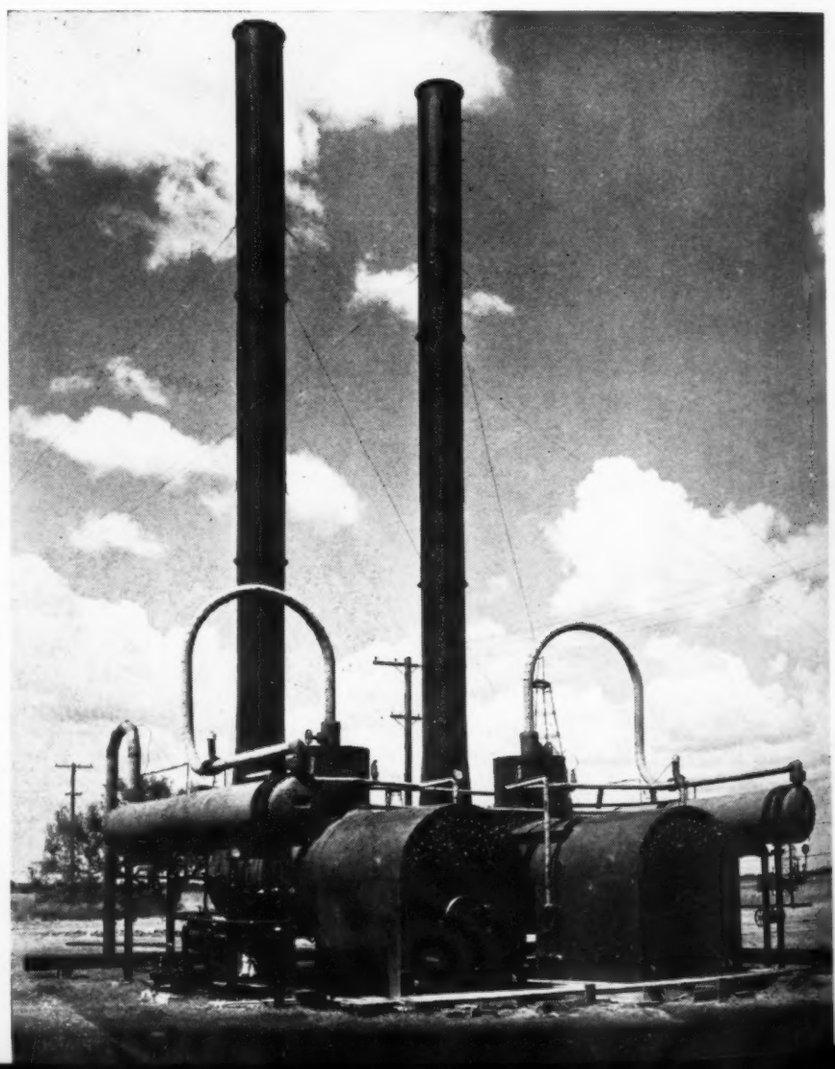
By J. L. MASSIE

Difficulties usually encountered in the heating of oil emulsion solution prior to electric dehydration have been overcome by a novel application of specially designed heat exchangers recently installed by a major oil company at its Luling, Texas, properties.

This plant was originally installed by the United North and South Oil Company about 12 years ago. All oil from this company's property in the Luling field was brought in to this plant for treating. The original installation consisted of eight dehydrators, a 2000-bbl. heating tank, three receiving pits of 25,000-bbl. capacity each, and a battery of ten 70-hp. oil-field type boilers. There also was an electric generating plant consisting of two 50-kw. generators. The boiler plant supplied steam for heating the oil and for operating the pipe line pumps and the generating station. The heating system consisted of a 2000-bbl. tank containing several hundred feet of 2-in. steam line. The oil was run into the bottom of this tank through a distributor and taken over the top by the treater feed pumps. The operating temperature at the time was 140 deg. fahrenheit.

The peak capacity of the plant was 42,000 bbl. per day, which was maintained for a period of approximately two months. After the field was completely drilled, production gradually dropped off, and at the present time the plant is handling approximately 5000 bbl. of oil daily.

At the time production declined to approximately 15,000 bbl. per day the old heating tank was discontinued and a battery of heat exchangers installed. Later, due to a shortage of gas and troublesome boiler feed water, the steam-heating system was discontinued and four boilers installed for direct heating. Several of these boilers caught fire, and finally it was decided to remove the regular flues and weld in 4-



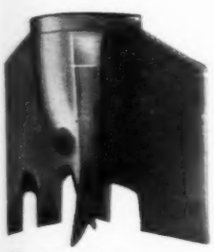
Close-up view of heating plant that solved the emulsion treating problem discussed in this article

for 1927 10 years

PROVED & ACCEPTED

Today, as for 10 years, the Globe Type B or C Bit is acknowledged to be the "Leader" for drilling FAST, STRAIGHT, FULL GAUGE hole in ANY formation which can be cut with a drag-type bit.

Shank



Type B Head, Side View

Five circulation holes keep new formation exposed to the bit.

Staggered teeth eliminate key-seating. This design affords necessary depth of penetration to insure maximum footage and cutting speed.

Strong, short shank constructed of special alloy steel —heat treated for additional strength.

Long reaming edges maintain full gauge hole. A 4-point contact with the formation is provided, steadying the bit and insuring smooth cutting action. Cutting and reaming edges are set with diamond substitute inserts and faced with diamond substitute compound.

Teeth and reaming edges can be repeatedly rebuilt without warping bit box.

Replaceable hardened choke nipples permit substantial savings in operating costs.

Refer to your Composite Catalog or write us for complete details.

Type B Head, Bottom View

Type C Head, Bottom View

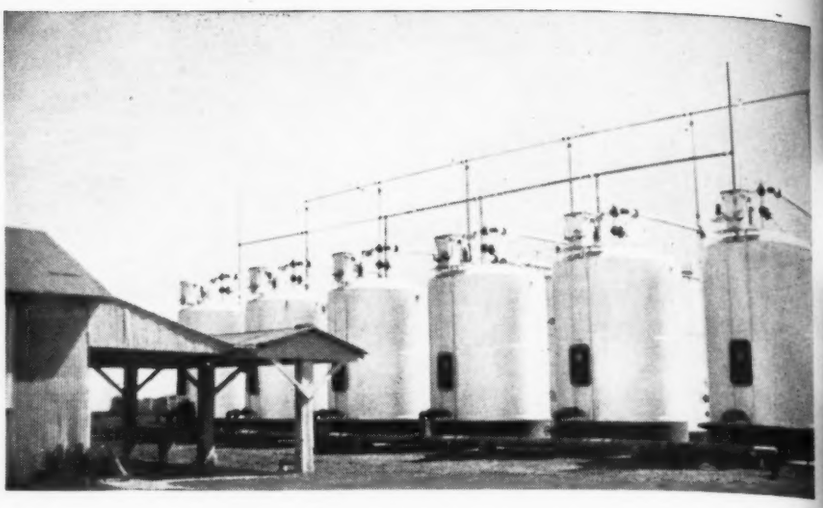
GLOBE OIL TOOLS CO.

Los Nietos, California (Los Angeles County)

158 No. Second St. Laramie, Wyo. 30 Rockefeller Plaza New York City 3118 So. Robinson Ave. Oklahoma City, Okla.

FAST HOLE GUAGE STRAIGHT

GLOBE TYPE B BIT



Another view of electric dehydrator battery showing the controls

in. tubes. This gave a reasonably satisfactory heating system until another fire occurred, which resulted in the installation of new equipment.

The original dehydrators were replaced in November and December, 1935. Six treaters of a newer type were installed to replace the eight old style ones that had been in operation since the original installation.

The original specification on the treated oil was two percent B.S. and W. Later on, this specification was cut to one percent, and later still to 5/10 of one percent. This has reduced successively the capacity of the dehydrating system from 6000 bbl. daily per unit to about 1500 bbl. daily per unit, and has called for an increase in operating temperature.

Another change was the installation of flow stations in the field. At these stations a large volume of water is allowed to separate from the oil, leaving a very tight emulsion, averaging about 50 percent, to be handled by the central treating plant, approximately 10,000 bbl. per day. While this system has been very successful in reducing the amount of pumping required to gather the fluid, it also has had the effect of leaving nothing but the most difficult emulsion in the oil, and has resulted in the emulsion being made more difficult by aging. In fact, when the emulsion reaches the central plant, it consists of little more than wet mud. The water included in the emulsified oil contains so much mineral matter that all drain lines from the dehydrating system are constantly being stopped up by the formation of an extremely hard scale. In addition to this scale-forming substance, the water also contains magnesium salts, which are highly corrosive. These salts, in combination with the sulphur present in the oil, have made the corrosion problem at this plant extremely severe, and has necessitated the replacement of the stock tanks several times. It also has been a source of trouble in all the previous heating systems.

An indirect method of heating the emulsion through the medium of heat exchanging apparatus was conceived as being the most practical and economical for the services involved and this method was proposed to manufacturers for study and applications.

Of several widely different designs of plants offered, the final selection was the system proposed by the Henry Vogt Company, who built and erected the entire heating plant on a turnkey basis. The accompanying flow sheet (Fig. 1) shows the diagrammatic hook-up of the system.

The oil emulsion obtained from wells in the field contains as high as 98 percent water. The crude itself has an asphaltic base of a 26-28 A.P.I. gravity and forms a very stable emulsion. As much water as possible is separated in the field by ordinary settling methods, so that about 50 percent crude and salt-water emulsion is delivered to the heating plant.

For satisfactory treating of the emulsion in the electric dehydration plant, designed and installed by The Petroleum Rectifying Company of California, it must be heated to 180 deg. fahrenheit.

The entire plant is designed to handle 10,000 bbl. of oil emulsion daily, and is arranged for twin operation, with 5000 bbl. flowing through each system.

Each system is complete with a duplicate set of boilers, exchangers, return condensate systems, and all auxiliary equipment, so that one-half of the plant can be shut off without affecting the operation of the other half. The only exception is the boiler make-up feed pump, which is cross-connected to the two boilers, the use of which is very infrequent since the only water loss is that equivalent to the steam required to operate the small condensate pumps.

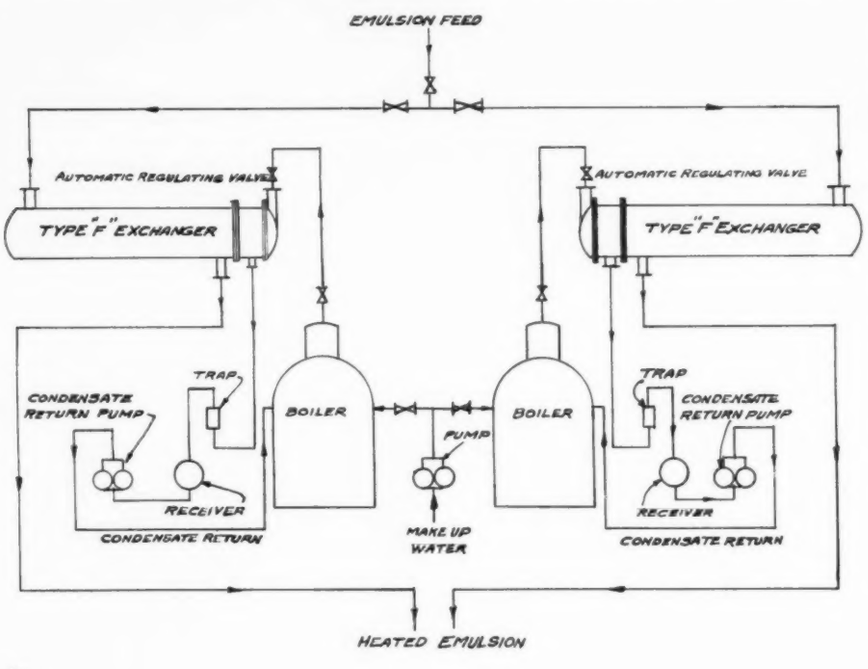


Fig. 1. Flow diagram of plant for heating emulsion

BRIDGEPORT

Mechanical ROTARY DRILLING RIGS

TELEPHONE

"station-to-station" —from anywhere at anytime

• Built in several sizes for a wide range of duties, Bridgeport Mechanical Rotary Drilling Rigs meet the current requirements for cheaper, more convenient and more efficient methods of drilling. Each size, scientifically engineered and field proven, has demonstrated its ability to easily handle the type of drilling for which it is designed.

Powered with internal combustion engines ranging in size from 150 to 325 h. p. each; and utilizing either natural gas, gasoline, butane or oil fuels, these Rigs materially reduce operating costs, lower the equipment investment and increase drilling profits.

Ask for specifications, prices and terms on the size and type designed to meet your specific requirements.

For complete specifications, engineering data and full details, write for Bulletin No. 60, or telephone our nearest representative.

These Rigs, in all sizes, are carried in stock ready for immediate delivery anywhere.

BRIDGEPORT

MACHINE COMPANY

MANUFACTURERS DISTRIBUTORS

OIL DRILLING-FISHING AND PRODUCTION EQUIPMENT

GENERAL OFFICE AND WORKS WICHITA, KANSAS

Eastern and Export Office: 30 Rockefeller Plaza, New York

HOUSTON . DALLAS . SAN ANTONIO . CORPUS CHRISTI . SHREVEPORT . ODESSA

TULSA . OKLAHOMA CITY . WICHITA . NEW YORK CITY . AND BRANCH STORES

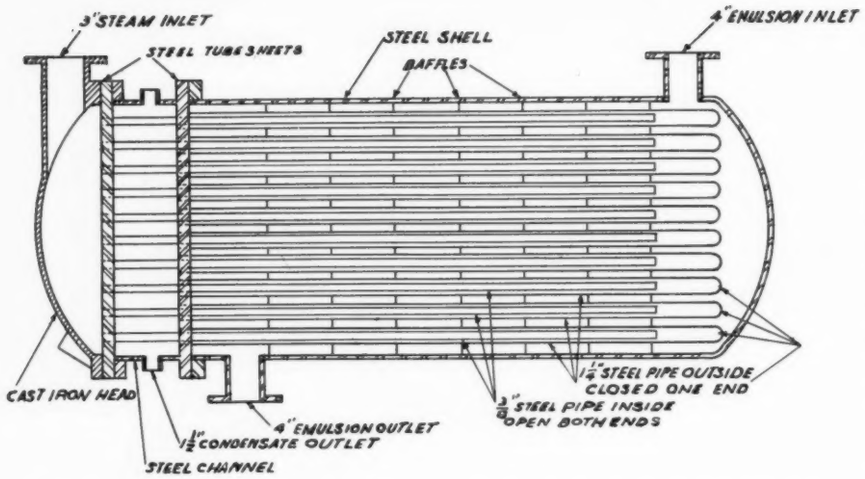


Fig. 2. Diagram of Type F emulsion heater

Two Lucey 84-in. rivetless fire-box oil-country boilers are used to generate steam at a pressure of 150 lb. for the exchangers and pumps. The boilers are designed for steam generation at 200 percent rating of 104 hp. at 300 lb. pressure. These boilers are insulated with Lucey removable steel-jacketed casing. One of the important considerations in selecting these boilers was their adaptability for other oilfield work in the future.

The amount of steam admitted to the Vogt F type exchangers is regulated by direct-acting controllers, which maintain the outlet temperature of the emulsion from the exchangers at 180 deg. fahrenheit.

The condensate from the exchangers is discharged by traps to 5¼-in. by 3½-in. by 5-in. pump receiver units that automatically return the condensate to the boilers.

Each of the heat exchangers has a capacity for heating 5000 bbl. of emulsion daily to 200 deg. fahrenheit. This rating is based on 15 lb. steam pressure. A greater capacity may be obtained by increasing the steam pressure. The construction of the exchangers is very unusual and merits further description.

The tube surface of the exchanger is made up of a nest of tubes, one end of which is rolled into a tube sheet and the other end closed by a special process. Into these tubes are inserted tubes of a smaller diameter rolled into a separate tube sheet. These smaller tubes serve as conduits leading the steam to the larger pipes that comprise the heat-transmitting surface. It will be seen from an accompanying illustration that both tube nests are removable and that each tube can expand independently of the others. In this respect it is equivalent to an exchanger having a floating head for each tube. The internal baffling of the exchangers is such as to facilitate blowing out sludge that may be formed in heating the emulsion. These exchangers can be seen in the foreground of the accompanying plant picture elevated above the ground on stands.

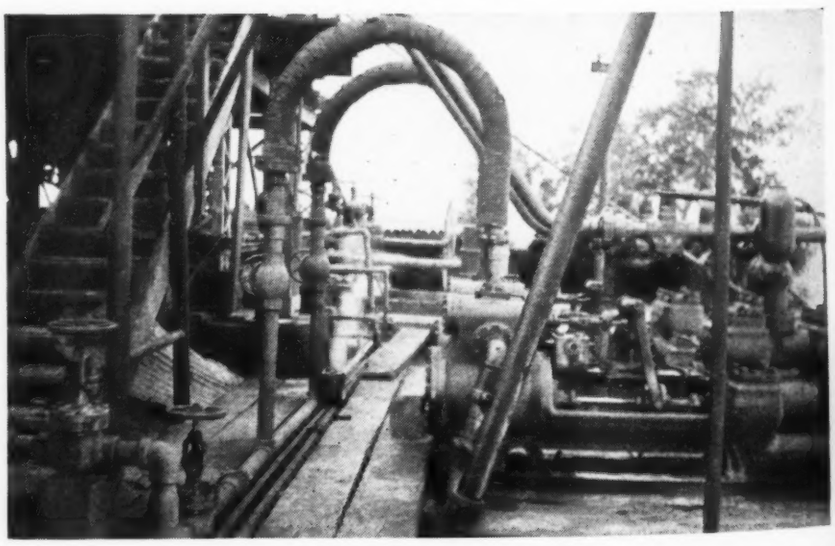
Fig. 2 shows the details of one of the heat exchangers.

A 1½-in. layer of mineral wool followed by 2¼-in. coats of plastic and a heavy final layer of Eagle Insulseal comprise the insulation of the exchangers. The steam piping is entirely insulated with 85 percent magnesia covering. All equipment was coated with a water-proofing material for outside operation.

The plant equipment is automatically controlled in every respect including the control of gas fuel to the burners, through steam pressure and boiler damper regulation, and the condensate return system that operates through an enclosed-float control-receiver tank, which is foolproof and requires very little, if any, attention.

In making the plant layout simplicity of operation and flexibility were kept foremost in the minds of the designing engineers. The result is a compact and well-functioning plant.

Unusual Method of Connecting Steam Line to Slush Pumps

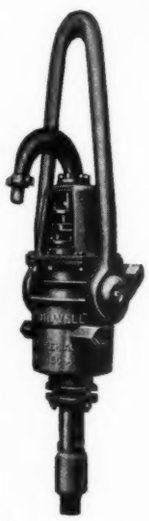


AN unusual method of connecting steam line to slush pumps is shown in the accompanying illustration. As noted, the steam line is carried overhead, suggestive of cracking plant construction practice.

This photograph was taken at The Texas Company's well No. C-14 Pierce Estates in the new Withers field of southern Wharton County, Texas Gulf Coast.

A giant of strength on the job. Extra strong center truss eliminates center pin deflection. Base made of heavy 24" CB-section beams. "OILWELL" #300 Crown Block with Mid-Continent Type Sand Line Sheave Mounting.

Just as safe, strong and speedy as it is big, "OILWELL" 80" Streamline Traveling Block.



"Oilwell" No. 150-B Oilbath Rotary Swivel, as shown here, has been used in drilling some of the world's deepest wells. The new Di-Hard Water Tubes inlaid and overlaid with Di-Hard Metal are establishing records for long life.

MATCH THEM UP FOR *Best Performance*

FOR heaviest duty, use the "OILWELL" #300 Crown Block, 80" Streamline Traveling Block and the #150-B Oilbath Rotary Swivel — no job of drilling has yet proved too heavy for this combination. For lighter work, match up the #200 Crown Block, 66" Streamline Traveling Block and #100 Oilbath Rotary Swivel.

USE ONE SET OR THE OTHER FOR ECONOMY	HEAVY DUTY	HEAVIEST DUTY
"OILWELL" Crown Block -	#200	#300
"OILWELL" Streamline Traveling Block - - - - - -	66"	80"
"OILWELL" Oilbath Rotary Swivel	#100	#150-B

Sheaves for the No. 200 Crown Block and 66" Traveling Block are interchangeable as are also the Sheaves for the No. 300 Crown Block and 80" Traveling Block. Water Tubes for the No. 100 and No. 150-B Swivels are interchangeable.

OIL WELL SUPPLY COMPANY

Branch Stores in All Oil Fields

Subsidiary of United States Steel Corporation

"OILWELL"

REG. U.S. PAT. OFF.

Distribution Transformers and Their Protection

By W. C. LANE

This equipment, of vital importance to the widespread use of electricity in the oil field, is here described, and pertinent facts given regarding its care

THE transformer, more than any other device, is responsible for the extensive use of electrical energy in the oil field. If it were not for this appliance electricity could be employed only in the immediate vicinity of the plants in which it is generated and plants would be small.

From the standpoint of mechanical construction a transformer is one of the simplest devices in general use, but in reality many years of research have been spent in developing the materials used in them, and in determining the most efficient way to arrange their parts. Fundamentally there are only three working elements: (1) the high-voltage winding, (2) the low-voltage winding, and (3) the iron core on which they are assembled. Of no less importance, however, are the insulating materials and the oil in which the transformer proper is immersed.

The manner in which the windings are associated with a transmission line is shown in Fig. I. The terms primary and secondary are used somewhat loosely, but in general it may be said that they refer to the position a winding has in a network. In the accompanying sketch, Fig. 1, the low-voltage winding of transformer No. 1 is the primary, and the high-voltage coil is the secondary. The distinction generally given is that energy is supplied to the primary and delivered by the secondary.

The efficiency of a transformer is remarkably high, irrespective of its capacity, that of one 5-kva. unit in mind being 97.4 percent as compared with 98.9 percent for one having 100 times this capacity. Energy must be spent in forcing the current through the primary and the secondary windings and in magnetizing and demagnetizing the iron core. In addition to this, eddy currents, which perform no useful work, are set up in the sheets of iron composing the core, in the supporting framework, and in the copper of the coils themselves.

In modern designs the losses have been reduced materially by the use of a better grade of iron for the core, and improved types of insulation. Better iron makes it possible to use shorter cores of less cross section. This, together with the use of superior insulation, reduces the length of the copper conductors used in the two windings, and their resistance is decreased in the same proportion. Since the magnitude of the losses are directly proportional to the amount of iron in the core, and to the resistance of the windings, the high efficiencies obtained should be credited to the metallurgists.

There being no moving parts in a transformer, all the energy lost in it appears in the form of heat. Under a uniform load heat must be transferred from the interior working parts to the surface of the enclosing tank at a constant rate or the temperature will rise indefinitely. Oil is the medium by which the transfer is made and the force of gravity causes it to circulate. It is fortunate that a liquid could be found that is a good insulator, for without oil or some other highly resistant liquid it would be exceedingly difficult to build a power transformer.

From one-third to one-half the volume of the enclosing tank is occupied by the working parts, the remainder of the space being used to bring out the leads, for tap changers, protective devices, and to accommodate the oil needed for cooling purposes. The radiating surfaces of the tanks are increased by adding fins, corrugating the case, or in resorting to some other device. Unfortunately oil is a combustible, and fires or explosions result occasionally from its use. A synthetic substitute for oil has been developed that is non-inflammable, but it is not in general use

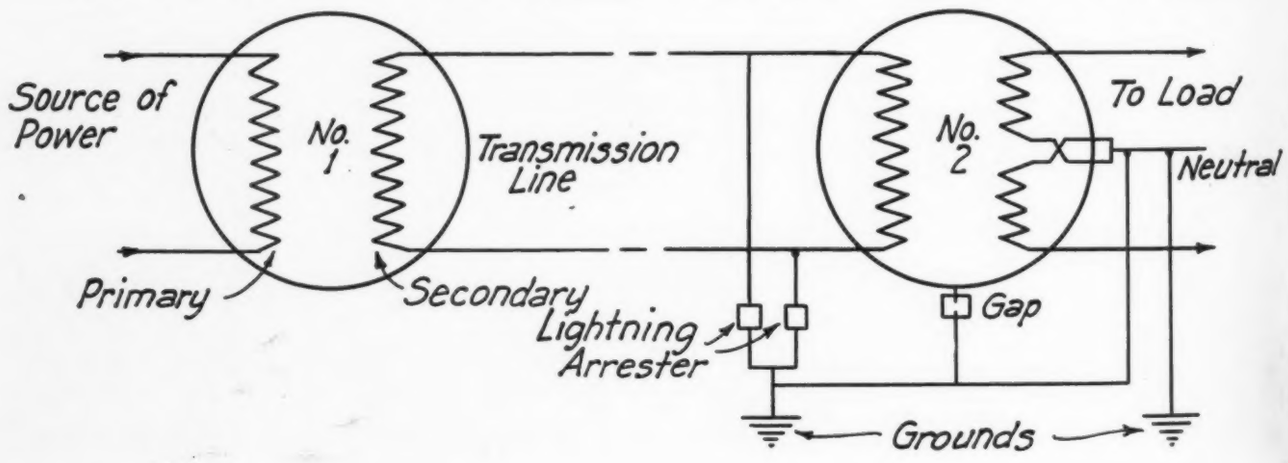


Fig. 1. Step-up and step-down transformer showing method of grounding the transformer for increasing protection against lightning

as yet, as its cost is much greater than that of oil.

Since the efficiency of a transformer is so high, little additional improvement along that line is possible. The chief efforts of designers are now being devoted to increasing the life of the equipment, and to increasing the reliability of the service. New materials have been developed for use in lightning arresters and old principles have been revived and applied in new ways for obtaining the desired effects. Despite the increase in knowledge concerning lightning, it still is a very troublesome factor in transmitting power.

It has been found by experimenting with artificial lightning that the ordinary 2300/4000-volt transmission line will flash over at the insulators and other points when a surge having a crest voltage of approximately 400,000 volts is impressed on it. Such a line might carry a 350,000-volt surge to a transformer bank. It is uneconomical to attempt to insulate against such a voltage. A better practice is to install an arrester to reduce the potential to a value that is within the range of the insulation it is possible to apply to a commercial transformer. It is interesting to note that the choke coil, a device that was in wide use a few years ago, and was thought to prevent the entrance of surges, has been found to have no virtue.

Fig. 2. Distribution transformer equipped with lightning arresters, overload circuit breaker, and co-ordinated secondary bushings so constructed that a surge on the secondary wires will flash over to the case. Clamps on primary leads are arranged so that connections to line may be made with "hot stick"

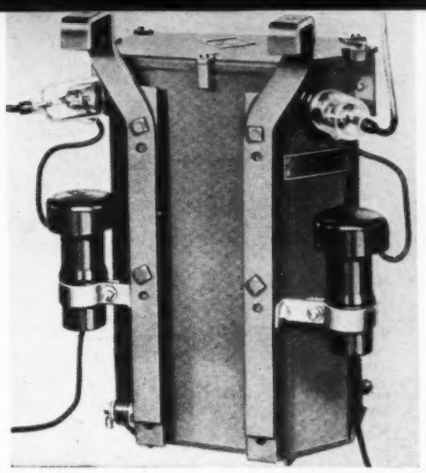


Fig. 3. The surge diverters are placed outside the tank on this transformer. The primary leads terminate in mechanical connectors housed in a glass protector. Grounding gap may be seen near bottom of tank

The function of an arrester is to detour the surges to the ground and while doing this to keep the voltage over the windings low enough that the latter will not be injured. During the time this is being accomplished the service must be maintained. It is said that only about one surge out of 20 is the result of a direct lightning stroke. The ordinary induced discharge varies from a few hundred to one or two thousand amperes and lasts for from ten to 100 millionths of a second—a current that is equivalent to one or two amperes per second and is not enough to burn out a 2- or 3-ampere fuse. The damage for anything other than a direct stroke usually results from the power follow current and it is the function of the arrester to stop this before it can harm the arrester or burn out the fuse links.

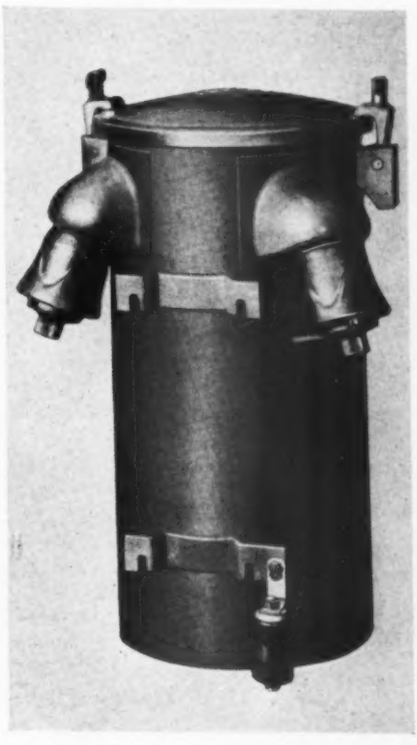
When an impulse, passing along a line seemingly in search of an easy path to the ground, reaches a transformer or the end of a line its behavior is very similar to that of a train of waves in water. The first water wave to strike a high bank is reflected backward and when it meets an oncoming wave it unites with it and forms a new wave approximately twice as high. Unprotected apparatus may be subjected to about twice the surge voltage as a result of a similar reflection of an impulse.

No attempt will be made here to give the details of the protective devices developed by the different manufacturers. They are all intended to perform the same function; that is, to act as a valve that opens when a surge appears, and while passing a charge to the ground to do it in such a way that the voltage over both transformer windings will be less than that at which they will fail. After the charge has been passed the valvular action must cause them to close and prevent the current from the line from making trouble. From the standpoint of probabilities records seem to indicate that a transformer will not receive a direct stroke more than once in 25 or 30 years so that it is not economical to attempt to install arresters on ordinary distributing banks that will stand a direct stroke without injury.

Modern types of distribution transformers are available that are complete within themselves or are so constructed that it is possible to apply whatever protective devices may be needed. The exact method of grounding the parts depends not a little on the point of view of the engineer in charge. The manufacturer is likely to regard long life of apparatus and continuity of service as the most important things, the underwriters the fire hazard, the oil company's "safety man" the "lost time accident," while the central station operator must have a point of view that covers all these phases.

Fig. 2 shows the interior of a transformer in which all the protective devices, with the exception of a grounding gap, are placed within the tank. These include two lightning arresters of the divided gap type, protective links, and a circuit breaker in the secondary. The temperature relays for actuating the breaker are under the oil so that an excessive oil temperature, as

Fig. 4. Transformer with arresters enclosed in primary bushings. Connections to neutral or to tank arc made within tank. Grounding gap shown near bottom of case



well as an overload current, will cause it to operate.

In Fig. 3 the surge diverters are placed on the outside of the tank, a practice that appears to be sound, for when a surge from a direct stroke of lightning does strike an arrester it is likely to shatter it into bits and one can imagine what a pie this would make if it took place within a tank filled with oil. In Fig. 4 the arresters are outside the tank and are built integral with the primary bushing. Coördinated bushings are used on the secondaries of the three transformers shown as a means to get rid of chance surges that may originate on the low-voltage lines. These bushings are so constructed that a surge originating on the secondary line will flash over the bushing to the case and then go to the ground.

A comparatively new practice that has gained much in favor during the last four or five years and has just been accepted by the underwriters appears to reduce lightning troubles more than 50 percent. This is the interconnection of the ground lead of the primary lightning arresters with the neutral of the secondary winding as shown by transformer No. 2 of Fig. I. It is to be recommended where it can be used without introducing other complications.

The secondary windings of the 3-phase banks in common use in the oilfield are usually arranged in Delta so that there is no neutral. It is bad practice to tolerate a ground on a low-voltage system serving a group of pumping wells, as it introduces a fire hazard needlessly. In such a case a chance ground on either of the other two ungrounded wires to a metal building or in a conduit is likely to start an arc that will last indefinitely. Such an arc will blow itself out in a few cycles if the circuit is ungrounded elsewhere.

The amount of protection a bank should have depends much on the kind and number of storms likely to occur in the particular region during a year's time. If the secondary circuits are long, such as on a 440-volt system used in pumping, it is well to protect both the primary and the secondary windings with suitable sets of arresters, and if separate grounds are used the ground leads should be interconnected. It does not appear that the tank itself enters into the problem of protecting the windings in such a system but as a matter of safety to linemen it is well to ground the tanks either directly or through a suitable gap.

Too much emphasis cannot be placed on the importance of having good grounds. These should be checked regularly and if the resistance is too high steps should be taken to improve the conditions. In one instance observed by the writer three strokes were registered at a pump station in one spring lightning season. An investigation showed that the hill on which the station was situated was nothing more than a knoll of clean gravel that had been covered with a few inches of soil by the wind.

Thus far nothing has been said about protecting the rotating machinery driven from the bank of transformers. It is a physical impossibility to insulate motors and generators to withstand as high voltage as that applied to transformers. Simple installations such as pumping wells may be protected by a set of arresters placed at the well house. Many operators simply assume the risk and provide no protection on individual pumping installations. Pipe line pump stations should be protected by a set of arresters situated approximately 1500 or 2000 ft. from the station proper and by a second set at the station. In addition to the arrester at the station a capacitor should be placed at the terminals of the rotating apparatus as a means to reduce the strain on the insulation.

Combating Corrosion in Sucker Rod Service

MANY methods of producing an oil well have been developed but the oldest and the one most universally employed uses sucker rods to operate deep well pumps.

As oil development expanded in this country and in foreign fields many grades of oil were produced and great variations in operating conditions were encountered. As the wells were drilled deeper increased strength in the steels used for sucker rods was often sufficient to handle the increased pumping load. In many fields, however, corrosive conditions were encountered where high strength alone was not sufficient and it was necessary to develop metals having inherently high resistance to corrosion and to embrittlement.

Corrosive conditions in oil fields were not new but the damaging effect of such corrosion on steels subjected to repeated stressing was not properly recognized until recently. Extensive fatigue tests in the presence of corrosive waters and sulphides, and reliable field data from areas subjected to such influences now permit selection of the proper steels for these different pumping conditions.

It is now recognized that corrosive fluids may be expected sooner or later in most wells. Due to such corrosive conditions the fatigue value of metal is affected considerably. When operating under such conditions it is necessary to provide metals with a high degree of resistance to corrosion. Inherent plastic qualities and notch-toughness are also required to resist stress concentration and steels possessing these qualities maintain a high fatigue strength and permit operating at relatively high stresses under corrosive conditions.

Corrosive conditions are often aggravated by the presence of hydrogen sulphide. Embrittlement may occur more rapidly than the corrosion itself and represents the most severe type of service that sucker rods are called on to encounter. This embrittlement is often very rapid and always dangerous.

Nickel is a most efficient element for imparting the proper corrosive and embrittling resistance to steels used for sucker rods. Different percentages are used for varying conditions but the two types of rod tabulated in the accompanying table represent modern practice.

Both these rods are designed for operating stresses of 30,000 lb. per sq. in.; Grade 80 rod is for corrosive fluids that do not contain excessive sulphides.

Where the sulphides are more severe the higher nickel, lower metalloid Grade 90 rod may be employed.

SUCKER RODS FOR CORROSIVE AND SULPHIDE CONDITIONS

PHYSICAL PROPERTIES

Grade	Yield Point	Ult. Tens. Str.	% Elong. (2-in.)	Red. Area %	Izod Impact	Endurance Limits: Air	Endurance Limits: Non-Sulphide Corrosion	Endurance Limits: Sulphide Corrosion
80	50-60000 lb./in.²	80-90000 lb./in.²	30	65	98	48600	33000	18900
90	50000 lb./in.²	65000 lb./in.²	35	70	103	47900	37400	23400

CHEMICAL COMPOSITIONS

Grade	C.	Mn.	Nickel	Molybdenum
80	.12-.18	.30-.60	1.50-2.00	.20-.30
90	.07-.12	.30-.50	3.25-3.75	.....

Excellence for Pipe Line Welding

LINDEWELDING is a result of the closely coordinated laboratory development, and field engineering facilities of the Linde organization, which has fostered the progress of oxy-acetylene welding and cutting in pipe line construction since its first use in 1911.

LINDEWELDING is an improved process of pipe line welding. It provides a ready means of improving the quality and strength of pipe line welds, and of insuring the uniformity of results and economy of materials and time. Its manifest advantages have today become so widely accepted that this method is the one by which other methods of joining pipe are measured. More than 6,000 miles of pipe lines have been Lindewelded. On each line Lindewelding has contributed dependability, speed, and low construction cost.

Lindewelding is dependable

The records of many projects indicate this. On one important project—covering many miles of 6-inch to 14-inch diameter pipe—the completed lines were tested and every Lindeweld was found to be "bottle" tight and has remained leak proof since. The line has operated perfectly for many months under a wide range of temperatures. Several months high pressure operation on another gasoline line has disclosed: (1) constant operation without interruption; (2) absence of defective welds.

Lindewelding saves time

On 42 miles of 10-inch diameter pipe Lindewelding effected a 25 per cent saving in welding time over older methods. On another line, ten miles of 8-inch pipe were Lindewelded in three days. The welding crew averaged more than 50 welds per man per day—a 50 per cent increase over the average previously established on 14 miles of the same line by another method.

The Lindeweld is strong and tough

With Lindewelding you can produce welds that are as strong as the pipe even when pipe base-material up to 110,000 lb. per sq. in. in tensile strength is used. Coupons cut from properly completed welds and tested to destruction on a tensile testing machine will consistently break outside the weld. Similar coupons, when cold-bent in a vise, show the great toughness and ductility of the Lindeweld. The Lindeweld will consistently withstand the standard 90 degree backward bend without any evidence of failure.

Let Linde Help You

The Linde organization has been identified with the welding of more than 20,000 miles of overland pipe lines. This extensive experience qualifies Linde engineers to assist you in organizing welding operations, to secure the greater strength, ductility and economy obtainable with Lindewelding. Why not have Linde Process Service help you on your next pipe line project? Address The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM LINDE UNION CARBIDE

Production of Premium Diesel Fuels

By GEO. M. WOODS

Part 2

The foregoing discussion has in a general way reviewed the characteristics of suitable fuels for high-speed Diesel engines. Within the limitations prescribed by the boiling range, there are available a wide variety of high-grade Diesel fuels. The following paragraphs will discuss in some detail the characteristics of Diesel fuel, with particular regard to possibilities of establishing large supplies of high-grade premium Diesel fuels from available crudes by careful selection of raw materials and suitable refining methods. In Table 2 are given inspection data on the "Diesel cut" from various domestic crude oils.

TABLE 2

CHARACTERISTICS OF DIESEL FUELS FROM VARIOUS CRUDES

Crude	Boiling Range, deg. fahr.	Gravity, deg. A.P.I.	Aniline Point, deg. fahr.	Diesel Index	Pour Point, deg. fahr.	Yield from Crude, percent
Pennsylvania	535-700	37.5	193	73	55	16
West Texas	545-710	36.0	198	71	50	22
West Texas	500-700	36.0	190	69	45	20
Panhandle Texas	510-720	35.0	181	62	35	17
Oklahoma City	550-700	35.0	179	63	35	16
East Texas	540-700	35.2	167	59	30	19
West Texas	450-700	33.0	153	51	10	25
Central Texas	500-700	30.0	152	46	—25	20
South Texas	500-700	30.0	137	41	—40	19
South Texas	500-700	26.0	132	34	—85	26

The most highly paraffinic Diesel fuel is that obtained from Pennsylvania crude. Mid-Continent crudes are next, while Coastal crudes are the poorest so far as paraffinicity is concerned. The paraffinicity is clearly shown in the general lowering of gravity, aniline point, and Diesel index for the various fuels. It will be noticed that the highly paraffinic fuels have very high pour points, while the low-grade Diesel fuels have extremely low pour points. This relationship is clearly shown in Fig. 2 which shows the curve produced by plotting the Diesel fuels listed in Table 2. This curve clearly demonstrates the impossibility of producing a high-grade Diesel fuel from straight-run stocks. The curve indicates that a straight-run Diesel fuel of 60 Diesel index will have a pour point of approximately 15 deg. fahr.; therefore, 15 deg. fahr. is the limiting temperature at which this fuel could be used, and probably the fuel supply would fail considerably above this temperature.

It is extremely difficult to set up any arbitrary limit regarding the quality of Diesel fuel that would be necessary to encourage development and make possible the operation of high-speed, light-weight Diesel engines. At the present time, however, the engines in use for bus and aircraft service, operated at speeds up to 2000 r. p. m., seem to require at least a 60 Diesel index for satisfactory service. Before Diesel fuel engines could become popular in mobile equipment under winter or cold-driving conditions it is believed that the pour point of the fuel would have to be reduced to approximately minus 30 deg. fahrenheit. The cloud point also would have to be reduced to at least minus 20 deg. fahr., which at once throws out all the straight-run Diesel fuels of 60 or above Diesel indices listed above. Thus, it is readily seen that if high-speed Diesel engines are to become popular, refiners are going to have to resort to new methods and prepare Diesel fuels that are much superior to any now available.

There are many methods that refiners of petroleum may employ to produce a better premium Diesel fuel that would help the high-speed Diesel engine business along considerably.

Possible methods of producing premium Diesel fuels are as follows:

(1) By hydrogenating straight-run or cracked Diesel fuels.

(2) By lowering the pour point of paraffin straight-run Diesel by:
   (a) Cracking,
   (b) The use of pour and cloud point inhibitors or depressors, and
   (c) Dewaxing.

(3) By solvent-treating:
   (a) Cracked Diesels, and
   (b) Low-grade straight-run Diesel fuels.

(4) By acid-treating:
   (a) Cracked Diesel fuels, and
   (b) Low-grade straight-run Diesel fuels.

(5) By selective blending of high-grade straight-run and low-grade straight-run and cracked Diesel fuels for low pour-point stocks.

(6) By adding "dopes" to selected Diesel fuels.

Each of the foregoing methods will be discussed in the following paragraphs.

It is understood that hydrogenation produces a very high grade Diesel fuel with an extremely low pour point from either straight-run or cracked Diesel fuels. As this method is available only to the "Standard Group" of refiners, it will not be further discussed.

The possibility of lowering the pour point of paraffinic Diesel fuel by mild

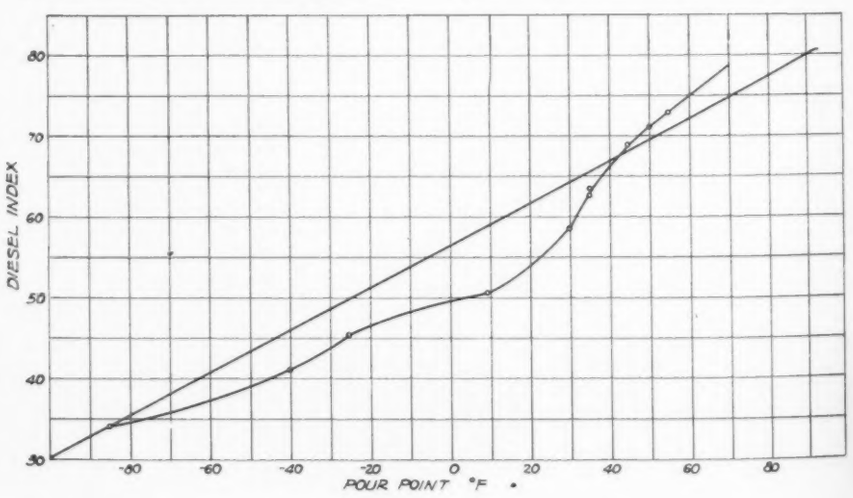


Fig. 2. Curve showing relationship between pour point and Diesel index for Diesel fuels from various crudes

INSTALL YOUR PIPE LINES RIGHT

IN CONSTRUCTION • Use G-E welding sets and electrodes
IN OPERATION • Use G-E pump motors, control, and generators

A pipe being arc-welded with G-E heavily coated electrode

EXPENSIVE leaks and service operations in pipe lines can be avoided by welding them correctly when they are installed. G-E welding machines, together with the specially developed G-E heavily coated electrodes, will give you welding results that mean trouble-free pipe-line operation. This equipment produces strong welds that make joints leak-free, eliminating a danger and reducing maintenance costs.

Dependable equipment for drive and control is essential in pumping installations. G-E motors and control will give reliable service continuously for many years. They embody the results of our years of experience in supplying the oil industry with driving equipment.

In locations where purchased power is not available, Diesel-driven G-E generators will efficiently operate pump motors.

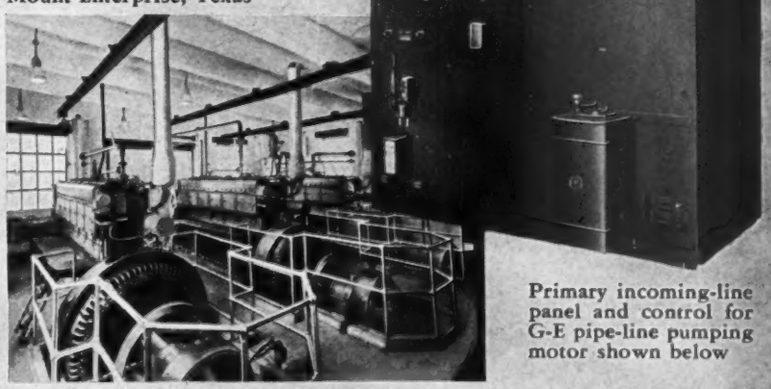
For further information about G-E equipment for pipe lines, get in touch with the nearest G-E sales office. Our representatives will be glad to help you with your problems. General Electric Company, Schenectady, N. Y.

020-225H

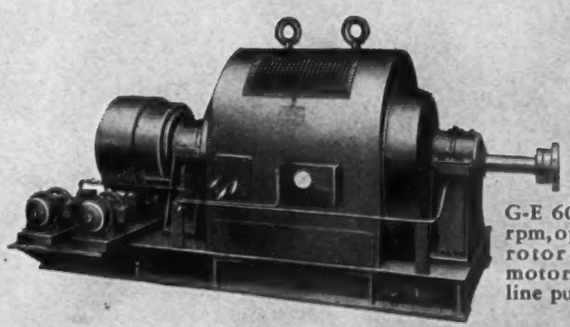
G-E gas-engine-driven welders for pipe-line jobs

G-E heavily coated electrode for pipe-line welding

Three G-E alternating-current generators, each coupled to a Cooper-Bessemer Diesel engine, in oil-pumping station of the Atlantic Pipe Line Co., Mount Enterprise, Texas



Primary incoming-line panel and control for G-E pipe-line pumping motor shown below



G-E 600-hp, 3600 rpm, open, wound-rotor induction motor for pipe-line pumping

GENERAL ELECTRIC

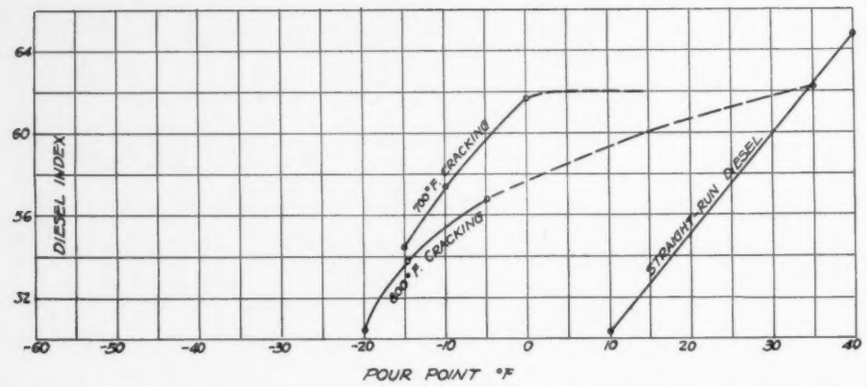


Fig. 4. Relationship between Diesel index and percent sulphur dioxide treat for cracked and straight-run Diesel fuels

cracking has been investigated to a limited extent. The stock used in the experiments was a Texas Diesel cut on which the properties are given in Table 2 (Panhandle Texas). Portions of this stock were placed in a small iron bomb and heated to 700 deg. fahr. and held there for various lengths of time. Other portions of this same stock were heated to 800 deg. fahr. and held there for various lengths of time. Following this cracking operation each cracked sample was rerun under vacuum and a blend made of the cuts to produce a stock of a boiling range approaching the original stock (500 to 700 deg fahr.). The cracking operation conditions and the results are shown in Table 3.

TABLE 3

CRACKING FOR PRODUCING LOW POUR POINT STRAIGHT-RUN DIESEL FUELS

CRACKING Temperature, deg. fahr.	700			800		
Cracking Time, Hours	2	4	8	2	4	8
Cracking Loss to Light Stock, percent	2.0	5.0	7.0	5.0	9.0	13.2
Cracking Loss to Heavy Stock, percent	0	0	0	0	0	0
Total Cracking Loss, percent	2.0	5.0	7.0	7.0	12.5	19.1
Boiling Range of Diesel, deg. fahr.	500-710	495-730	491-740	495-720	505-715	510-725
Gravity, deg. A.P.I.	35.1	34.0	33.5	34.1	33.9	32.6
Aniline Point, deg. fahr.	176	169	162	167	159	154
Diesel Index	62	58	54	57	54	50
Pour Point, deg. fahr.	0	—10	—15	—5	—15	—20

A study of the data in Table 3 indicates, as would be expected, the cracking of the Diesel fuel lowers the gravity, aniline point, and pour point of the resulting product. In order to lower the pour point from 35 deg. fahr. to minus 20 deg. fahr., a cracking loss of 19.1 percent resulted with a degradation of aniline point from 181 to 154 deg. fahr., of gravity from 35.0 to 32.6 deg. A.P.I., and a Diesel index of from 62 to 50, which places this cracked low pour-point stock in the unsatisfactory high-speed Diesel engine fuel class. A curve showing the cracking loss plotted against the pour point for cracking Diesel fuel under the preceding specified conditions is shown in Fig. 3. The relationship of the pour point to Diesel index for mildly cracked fuels using cracking conditions as specified is shown in Fig. 4. The relationship between Diesel index and pour point for natural straight-run fuels is drawn for comparison on the same plot. It appears from the preceding data that mild cracking has but a limited application in producing low pour-point Diesel fuels from high pour-point fuels, because of the degradation of Diesel index that accompanies the cracking method.

Pour-point inhibitors have been used for some time in motor oils. Wool fat has been used for many years for this purpose in Germany, while paraflow has become quite general in use in this country during the past few years. The possibility of lowering the pour points of Diesel fuels by means of wool and fat and paraflow accordingly was undertaken. The effect of adding various amounts of crude wool fat and paraflow to various Diesel fuels on the pour points is given in Table 4.

A study of the data given in Table 4 shows that both paraflow and wool fat are good pour-point depressors for the low pour-point Diesel fuels, but are not very effective on high pour-point stocks. Thus, 50 deg. fahr. pour-point Diesel was lowered to only a 40 deg. fahr. pour-point fuel by the addition of 1.0 percent paraflow, while a minus 40 deg. fahr. pour-point stock was lowered to minus 80 deg. fahr. by the same amount of paraflow. Like mild cracking, wool fat and paraflow appear to have only a limited application to the Diesel fuels; however, if a good cloud and pour depressor could be found for Diesel fuel, it would without doubt play an important part in the manufacture of premium Diesel fuels.

Dewaxing as a means of lowering the pour-point of motor oils has been in commercial practice for many years. Although there are many good dewaxing solvents that could be used for dewaxing Diesel fuel, only naphtha dewaxing was tried. Various Diesel fuels were blended with naphtha and chilled to low temperatures, the wax filtered off, and the Diesel-naphtha filtrate stripped of naphtha and inspected. The results are given in Table 5.

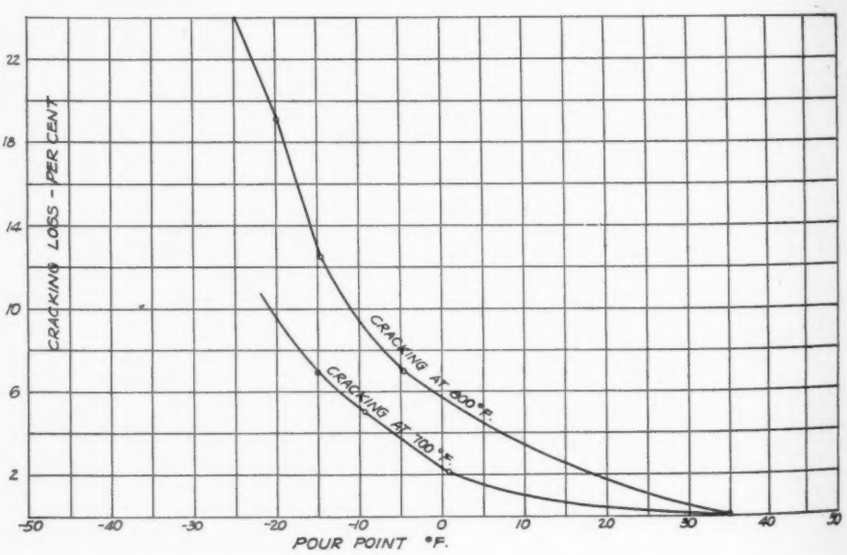


Fig. 3. Cracking Diesel fuel for pour-point lowering—Curve showing relationship of pour point to cracking loss for 700 and 800 deg. fahr. bomb cracking

IDEAL

"Reg. U. S. Pat. Off."

DIRECT ROTARY DRIVE

TYPE "A"

A 9 x 8 Ideal-Ajax Twin Steam Engine, equipped with a power-operated reverse or "steam kicker", drives the Rotary Machine directly, instead of using the large hoisting engine through the Draw Works. Increased operating efficiency is also secured by:

Less Wear on Large Hoisting Engine and Draw Works
Saving in Steam and Lubricating Costs
Better Control over Drilling Operations
Quieter Running when Drilling
Easier Spudding
More Usable Derrick Floor Space
Provides a Sturdy Stand-by Power Unit

THE NATIONAL SUPPLY COMPANY
OF DELAWARE

NSCO
REG. U. S. PAT. OFF.

National

TABLE 4
EFFECT OF WOOL FAT AND PARAFLOW ON DIESEL FUELS

Original Pour Point, deg. fahr.	55	50	45	35	30	10	—25	—40
0.1 percent Wool Fat Added	55	50	40	35	25	10	—30	—45
0.5 percent Wool Fat Added	50	45	40	30	20	0	—45	—60
1.0 percent Wool Fat Added	45	40	30	15	0	—10	—60	—85
2.0 percent Wool Fat Added	40	40	25	10	0	—10	—65	—85
3.0 percent Wool Fat Added	40	40	20	5	0	—15	—65	—85
0.1 percent Paraflow Added	55	50	35	30	25	5	—35	—50
0.5 percent Paraflow Added	40	40	25	15	10	—5	—40	—60
1.0 percent Paraflow Added	35	40	20	15	10	0	—45	—80
2.0 percent Paraflow Added	35	35	20	10	0	—15	—70	—85
3.0 percent Paraflow Added	35	35	15	5	0	—15	—75	—85

TABLE 5
DEWAXING DIESEL FUELS

	Pour Point deg. fahr.	Diesel Index
Original Stock	55	73
Dewaxed Stock	30	67
Dewaxed Stock	0	62
Dewaxed Stock	—30	58
Original Stock	35	62
Dewaxed Stock	0	58
Dewaxed Stock	—30	53
Original Stock	30	59
Dewaxed Stock	0	54
Dewaxed Stock	—30	49

The dewaxing losses incurred were large, especially in the production of low pour-point fuels; these losses, however, were not actually measured. It will be noticed that a steady loss in Diesel index occurs as the Diesel fuel is dewaxed. The Diesel index plotted against pour point for the various dewaxed fuels is shown in Fig. 5. A study of Fig. 5 discloses that dewaxing makes possible lower pour-point Diesel fuels for any given Diesel index than the corresponding straight-run fuel. Thus, as shown in Fig. 5, a fuel of a 60 Diesel index from a straight-run stock will have a pour point of approximately 30-35 deg. fahr. while a dewaxed fuel from a stock having an original pour point of 35 deg. fahr. can be dewaxed to a 60 Diesel index and 15 deg. fahr. pour, or a 55 deg. fahr. original pour fuel may be dewaxed to a 60 Diesel index and minus 15 or minus 20 deg. fahr. pour-point fuel. Thus, we have a ready means of producing high-grade Diesel fuels by dewaxing. The one serious drawback, however, is that raw stocks of high Diesel indices are required and these are very scarce, and the yields of dewaxed fuel is very small. Thus, it may be seen that the process of dewaxing stocks for the production of high-grade Diesel fuels has a limited application.

Solvent-treating offers a ready means of separating Diesel fuels into highly paraffinic and naphthenic fractions. It will be remembered that cracked Diesel fuels are characterized by low Diesel indices and low pour points. The latter low pour points are highly advantageous, and if these stocks could be solvent-treated to produce a high Diesel index low pour-point fuel, this method would offer a ready means of producing premium Diesel fuels. Inspection data on two representative cracked Diesel fuels produced in cracking for naphtha production are shown in Table 6.

Each of the cracked stocks in Table 6 was extracted with liquid sulphur dioxide at 25 deg. fahrenheit. The extractions were carried out by mixing

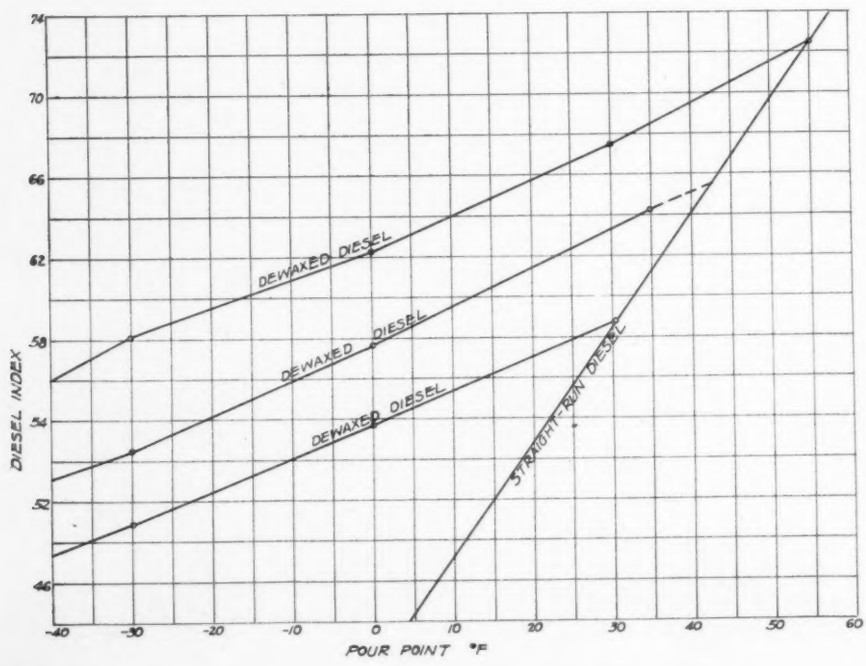


Fig. 5. Dewaxing Diesel fuels. Diesel index plotted against pour point

TABLE 6
INSPECTION DATA ON CRACKED DIESEL FUELS

Sample	1	2
Boiling Range, deg. fahr.	395-650	600-640
Gravity, deg. A.P.I.	33.2	32.4
Aniline Point, deg. fahr.	130	117
Diesel Index	43	38
Viscosity at 100 deg. fahr.	55	57
Pour Point, deg. fahr	—40	—50

equal portions of oil and liquid sulphur dioxide together and agitating for several minutes, then settling. The layers that formed were separated and the sulphur dioxide allowed to boil from each layer at atmospheric pressure and temperature. The last traces of the solvent were removed by caustic washing and steaming in an open vessel for several minutes. Successive extractions also were carried out on each of the stocks in a similar manner. Complete yield and treating results are given in Table 7.

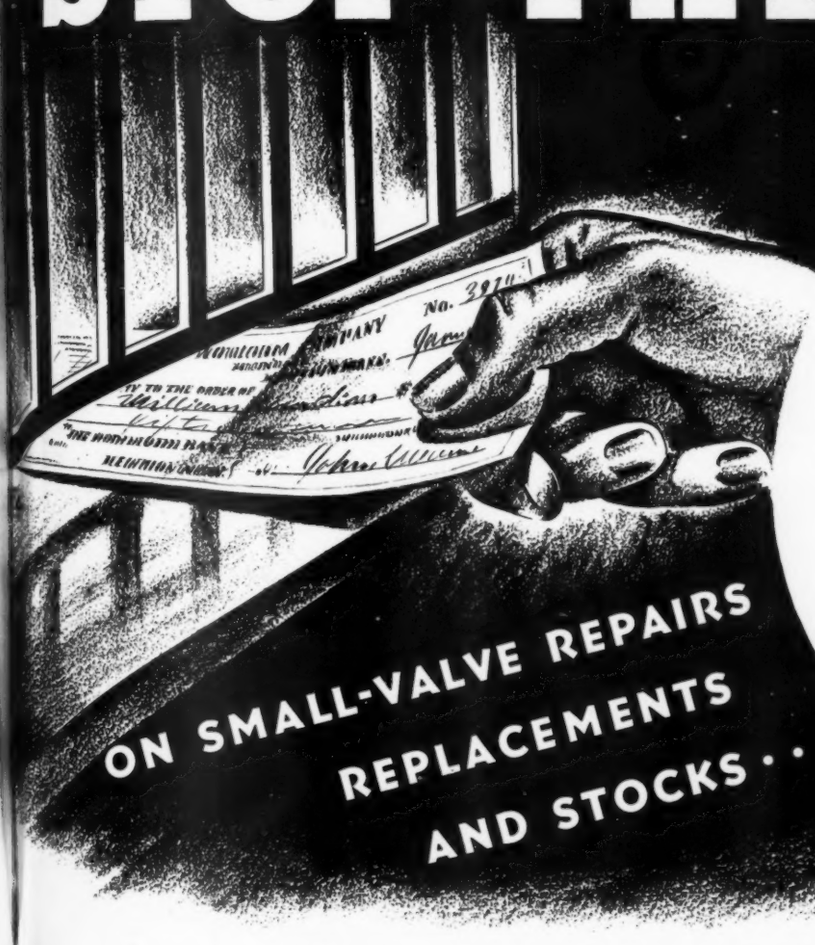
From the preceding data it appears that solvent-treating of a cracked Diesel fuel (produced by cracking gas oil for naphtha production) offers a ready means of producing a high-grade Diesel index and low pour-point Diesel fuel; but the large treating losses are a drawback to this method. The extract, however, can be used to crack further for a better gasoline. A curve showing the relationship between Diesel index on the raffinate and the percent sulphur dioxide treat is shown in Fig. 6. The raffinate that had been treated with 5x100 percent liquid sulphur dioxide, which resulted in a product with a Diesel index of 70 and pour point of minus 15 deg. fahr., was inhibited with 0.5 percent paraflow in an attempt to lower the pour point of this stock. Inspection data on this paraflow inhibited stock were:

Gravity, deg. A.P.I. - - 42.2
Boiling Range, deg. fahr. 390-635
Aniline Point, deg. fahr. - 166
Diesel Index - - - - - - 70
Pour Point, deg. fahr. - - —50

It will be noticed that the paraflow lowered the pour point to minus 50 deg. fahr., which was the pour point on the original stock. This Diesel fuel, incidentally, has the highest Diesel index and the lowest pour point of any fuel produced by any means discussed so far.

It will be remembered that cracked

STOP PAYMENT!

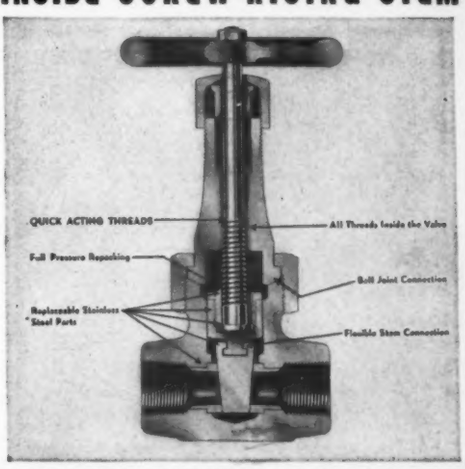


Standardize on CHAPMAN 960

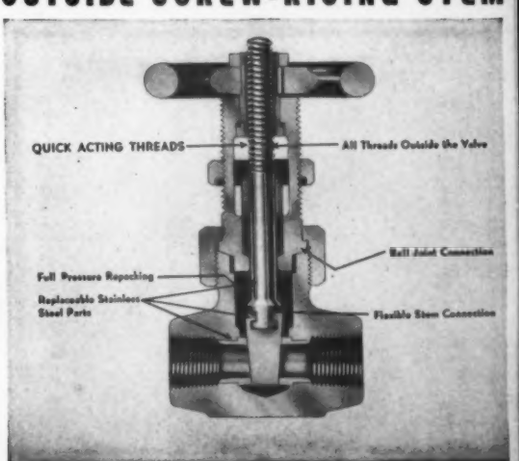
Free yourself from the steady extortion inflicted by small-valve troubles . . . put Chapman 960 in charge of flow on *all* small field and refinery lines. Then your small-valve costs will drop down out of sight—*and stay there for five years, at least.* You can use List 960 on all lines from ¼" to 2" . . . for all pressures up to 800 lb. at 750 F. And for cold working pressures of 2500 lb. up to the 1" size, with larger sizes up to 1500 lb. This valve comes in the two types shown, both of forged steel, with renewable stainless steel parts. Threads are quick-opening. And repacking may be done under full pressure when valve is open.

This money-saving gate valve is available in eight sizes—and in special alloys for extreme conditions—at the factory and warehouses. Get in touch with the nearest Chapman office for prices and delivery date.

INSIDE SCREW-RISING STEM



OUTSIDE SCREW-RISING STEM



GUARANTEE

The Chapman Valve Manufacturing Company agrees to replace without charge any working part or parts of any Chapman List 960 Steel Valve which fails within five years from the date of installation.

Branch Offices: Atlanta, Boston, Chicago, Cleveland, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, Salt Lake City, San Francisco, Syracuse, Tulsa.

The **CHAPMAN VALVE**

MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS

TABLE 7

EXTRACTION OF CRACKED DIESEL FUEL WITH SULPHUR DIOXIDE

Sample 1

Treat, percent	100		2 x 100		3 x 100		4 x 100		5 x 100	
	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.
Yield, percent	76	24	67	33	59	41	51	49	44	56
Gravity, deg. A.P.I.	38.7	16.1	41.6	18.0	42.3	21.2	43.0	23.0	43.4	25.2
Aniline Point, deg. fahr.	147	79	156	80	161	85	163	96	164	102
Diesel Index	57	13	65	15	68	18	70	22	71	26
Pour Point, deg. fahr.	—35	—50	—35	—50	—30	—50	—15	—50	—5	—50

Sample 2

Treat, percent	100		2 x 100		3 x 100		4 x 100		5 x 100	
	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.
Yield, percent	75	25	65	35	57	43	50	50	41	59
Gravity, deg. A.P.I.	37.2	20.4	40.3	21.6	41.0	22.9	41.8	23.0	42.2	25.6
Aniline Point, deg. fahr.	142	43	157	43	161	45	163	72	166	83
Diesel Index	53	9	62	9	66	10	68	17	70	21
Pour Point, deg. fahr.	—50	—50	—45	—55	—35	—55	—25	—55	—15	—60

TABLE 8

EXTRACTION OF LOW-GRADE STRAIGHT-RUN DIESEL FUELS WITH SULPHUR DIOXIDE

Treat, percent	None	100		2 x 100		3 x 100		4 x 100		5 x 100	
		Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.	Raf.	Ext.
Gravity, deg. A.P.I.	30.0	31.4	—	33.5	—	35.3	—	37.6	—	38.0	—
Aniline Point, deg. fahr.	152	156	42	159	48	162	56	164	72	166	85
Diesel Index	45	49	—	53	—	57	—	60	—	63	—
Pour Point, deg. fahr.	—25	—25	—	—25	—	—20	—	—10	—	0	—

TABLE 9

ACID-TREATING DIESEL FUELS

Stock	Cracked Diesel			Straight Run Diesel		
Acid Treat, Lb. per bbl.	0	10	50	0	10	50
Treating Loss, percent	—	6	27	—	7	25
Gravity, deg. A.P.I.	30.0	31.2	34.3	32.4	33.1	34.8
Aniline Point, deg. fahr.	152	155	161	117	123	139
Diesel Index	45	48	55	38	41	48
Pour Point, deg. fahr.	—25	—25	—10	—50	—45	—30

TABLE 10

BLENDING OF DIESEL FUELS FOR CONTROL OF POUR POINTS

High Pour Point, High Diesel Index Fuel, percent	0	20	40	60	80	100	0	20	40	60	80
Low Pour Point, Diesel Index Fuel (Straight Run), percent	100	80	60	40	20	0	100	—	—	—	—
Low Pour Point, Low Diesel Index Fuel (Cracked)	—	—	—	—	—	—	—	80	60	40	20
Gravity, deg. A.P.I.	26.0	28.1	30.2	32.0	34.1	36.0	33.2	33.8	34.4	35.0	35.6
Aniline Point, deg. fahr.	132	145	158	170	185	198	130	142	155	167	185
Diesel Index	34	41	48	55	63	71	43	48	53	58	66
Pour Point, deg. fahr.	—85	—55	—30	—5	25	50	—40	—25	—5	15	30

Diesel fuels are somewhat like low-grade Diesel straight-run fuels. Both are characterized by low pour points and low Diesel indices. Solvent-treating then also should offer a ready means of separating a low-grade straight-run Diesel fuel into highly paraffinic and highly naphthenic fractions. Accordingly, a sample of straight-run low-grade Diesel fuel was treated with liquid sulphur dioxide in the same manner as the cracked Diesel fuels. The results are given in Table 8.

It will be noticed that this straight-run stock does not respond quite so well to solvent-treating as the cracked Diesel stock (see Fig. 6); however, this method probably could be considerably improved by careful selection of suitable stock for solvent-treating.

The possibility of acid-treating cracked and low-grade straight-run Diesel fuels for the production of premium Diesel fuels was carried out. The stocks were acid-treated with various amounts of 98 percent sulphuric acid at room temperature. The treating was carried out in an open-top vessel, air being used as a means of agitating. The treated oils were settled overnight and the sludge layer withdrawn. The acid oil was steamed in the presence of caustic, later given several hot water washes, and finally blown bright. The results are given in Table 9.

Although a study of the accompanying results indicates that acid-treating offers possibilities for producing premium Diesel fuels, it is believed that the chemical costs would be too high for this process to become industrially useful. Solvent-treating would appear to be more feasible and less wasteful.

The possibility of selective blending of high-grade straight-run and low-grade straight-run and cracked Diesel fuels for low pour-point Diesel fuels was investigated. The results are given in Table 10.

The above data indicate that blending for pour-point control has only a very limited application in the production of high-grade Diesel fuels.

Because of the equipment necessary in order to test the various proposed "dopes" for Diesel fuels no work was carried out on this phase of the problem. Suffice it to say that the organic nitrates appear to be satisfactory and useful in improving the ignition qualities of Diesel fuels.

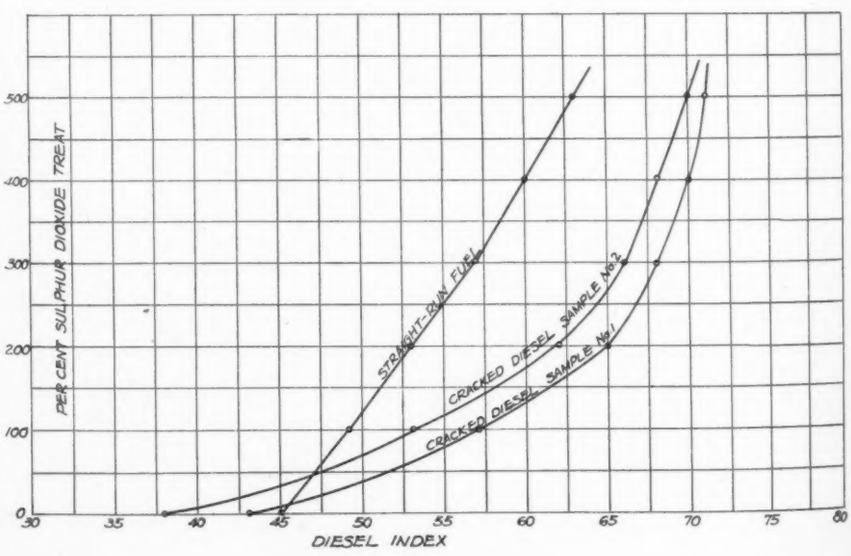


Fig. 6. Effect of cracking on Diesel index and pour point of Diesel fuels

Low Crankshaft Bearings Result in Misalignment

By JOS. L. INGRAM

THOSE having experienced a shaft failure under full load know the importance of correct alignment, and the amount of damage and wreckage involved, without taking into consideration the engine-hours lost while engine repairs are being made.

Most shaft fractures are the result of continued bending and torsional stresses. Even when the stresses do not reach the elastic limit of the metal, being repeated so many times finally results in a failure of the stressed part. This continued bending and twisting movement of the crankshaft is very important in the successful operation of large Diesel power plants, and a subject that the conscientious operator should thoroughly acquaint himself with and understand.

Crankshafts of the stationary engines usually are made of open hearth steel having an elastic limit of 37,500 lb. per sq. in., a tensile strength of 75,000 lb. per sq. in., and an elongation of 25 percent in two inches. In marine engines the steel used is of smaller carbon content, and of greater strength. To the operator this statement usually does not mean much. He wants to know what makes the crankshaft break.

When the crankshaft is out of alignment and one or more of the main bearings are lower or higher than the others it results in bending of the crankshaft as it revolves. When these bending stresses, combined with torsion, are repeated many times the endurance of the metal is exceeded; eventually this causes a fracture.

Such stresses also may be produced in single-throw and two-throw crankshafts by having counter-weights on the flywheel instead of the shaft, or by having a heavy flywheel at one end and the load take-off at the other.

The periodical inspection of crankshaft bearings to determine the amount of wear and misalignment caused by the lower half of the bearing shell being worn down is something that should not be neglected. The expense of making this inspection amounts to very little and results in the loss of but few hours engine time. Quite often the manufacturers of larger power units supply a bridge gauge for checking the bearing wear, and when the bearings are first adjusted stamp the clearance between points a and b (Fig. 1), on a smooth surface near the bearing. In using the bridge gauge one can see quickly the necessity of absolute accuracy in measuring this distance from a and b, and the importance of keeping the readings for future reference.

It is a simple matter to measure with inside micrometers, as shown in Fig. 2, the inside of the crank web at different points of throw. Better results can be obtained by using a dial indicator. Two center-punch marks should be made on each web and the indicator fitted so that the engine can be jacked around with it in place. This method will permit bending motion in any direction to one or ten thousandths of an inch. Next the dial indicator can be placed against the shaft itself, through the oil hole in the upper bearing half, and the engine revolved. The lowest position of the shaft can be read on the dial. It is necessary to leave all main bearings in their original adjustment when checking alignment. The bending motion shown in Fig. 2 is greatly exaggerated, of course;

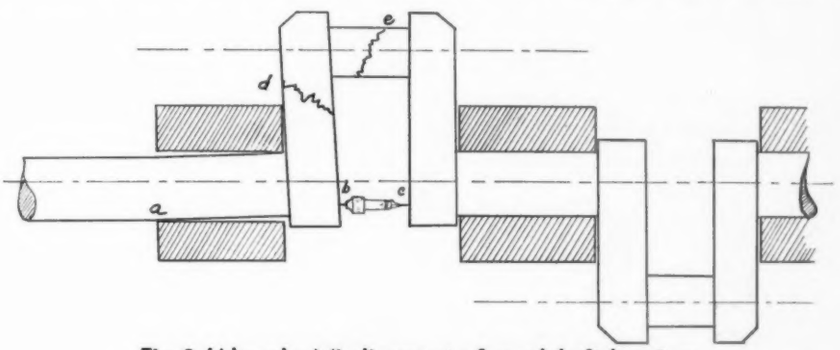


Fig 2 (Above)—Misalignment of crankshaft bearings

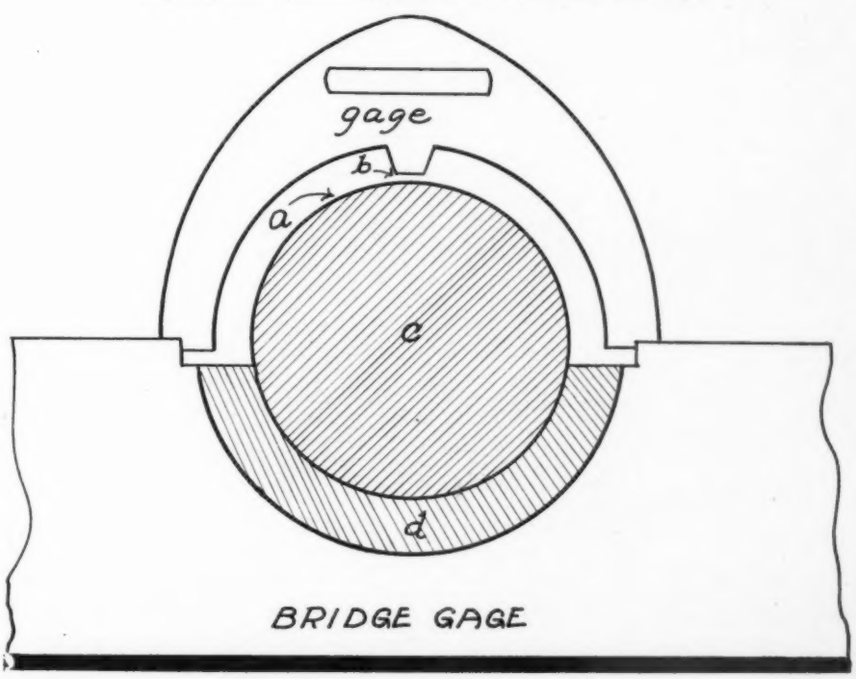


Fig 1

nevertheless it gives a good idea of the stresses imposed upon a shaft when out of line. Past experience has shown that when a shaft does break it usually occurs at points e or d, Fig. 2.

When the lower half of the main bearing shell is found to be low it should be remedied immediately—and correctly. To try to eliminate the noise by taking-up on the top half of the shell only tends to pull the shaft more out of line and make a bad matter worse. Worst of all is to try to raise the lower half of the shell with a sheet of shim stock.

The engine operator should be thoroughly acquainted with the condition of his main bearings at all times.

Big Spring and Other Fields in West Texas and Southeastern New Mexico Offer Varied Problems in Limestone Reservoirs

ACCUMULATION of oil in natural limestone reservoirs in West Texas and southeastern New Mexico depends largely upon the effective porosity and permeability of the producing formations, according to a recent report of the United States Bureau of Mines, Department of the Interior. However, fractured zones or cavernous conditions of high permeability allowing the unrestricted movement of gas and fluid mixtures within the reservoirs were suspected from the behavior of many of the larger wells. Each limestone reservoir in the West Texas fields displayed individual characteristics that made direct comparisons between reservoirs ineffectual.

A group of eight fields: Yates, Hendrick, Church-Fields-McElroy, Big Lake, Big Spring, Penn, and Westbrook in Texas, and Hobbs in southeastern New Mexico, ranking among the highest in total production, was selected for study by the Bureau as typical of the West Texas Permian Basin. The Basin comprises the area south of the Panhandle and west of the Bend Arch or Central Basin region, and contains 70 oil fields with 4200 producing oil wells. In most of the fields oil has been produced from limestone or dolomite of Permian age, although some of the fields produce from sandstone beds above the limestone, and in two fields production has been found below the Permian limestone in formations of Ordovician age.

The report, based on the authors' study of the typical fields over a period of several years, is in two parts. Part 1 presents a detailed study of the Big Spring field, and Part 2 gives brief discussions of the other fields in the group with pertinent data concerning them.

The Big Spring field, which is 21 miles long and one to two miles wide, is particularly noteworthy because it contains the greatest number of producing zones, namely, two in sandstone formations, and three in limestone formations. Complex reservoir conditions are revealed in the 2200-ft., 2500-ft., and 3000-ft. limestone-producing zones. Oil in the 2200-ft. zone has been found in several pay members of irregular thickness and varying degrees of saturation, and water appeared first on the high part of the structure. Variations as great as 150 ft. in the elevations of tops of pay of offset wells are not uncommon in the 2500-ft. zone.

Accumulation was more regular in the 3000-ft. zone, although in places it appeared to be divided into two or more pay members. Water encroachment in the 3000-ft. zone was extremely rapid and the entire producing area became flooded in a period of about two years. Corrective methods and remedial work adopted to reduce water encroachment were studied and described.

Results of hydrogen-sulphide determinations on the gas produced in the Big Spring field are given in the report, and the dangers of breathing this toxic gas are emphasized.

The Yates field is the most prolific shallow oil field ever developed. Initial production rates of the wells ranged from a few bbl. per day to 185,000 bbl. per day. Proration was adopted voluntarily by the operators. Virtually all the wells produced initially by natural flow, and eight and one-half years after discovery 95 percent of all wells in the field were still flowing. The Yates Engineering Committee was able to study the field as a unit because the operators adhered to the common-reservoir concept in which each lease is considered a part of the complete system.

During its flush period the Hendrick field was noted for a large number of gusher wells and rapid drilling under competitive operations. Water appeared early in all wells regardless of their position on the structure. One-third of all wells in the field have been plugged and abandoned due to water.

Approximately one-half the area in the Church-Fields-McElroy field was developed by competitive methods, whereas the other half was developed by controlled methods. The Gulf Production Company's No. 103 McElroy was drilled to test the Ordovician formation, and at the time of abandonment at a total depth of 12,786 ft. it was the deepest well in the world.

The recovery per acre from the 3000-ft. Permian limestone formation in the Big Lake field ranks highest among all the fields in West Texas, and the production to January 1, 1936, by natural flow, of approximately one million bbl. per well from 25 wells in the 8500-ft. Ordovician formation is an extraordinary record. Pressure-control drilling equipment made it possible to drill the 8500-ft. wells effectively, and special methods were introduced to utilize the reservoir energy for producing the oil.

The high degree of success attained in the development of the Hobbs field may be attributed to the full coöperation of the operators in applying scientific methods. A means of determining well potentials without making open-flow tests was devised to prevent waste, and special attention given to the reduction of high gas-oil ratios.

The Penn field exemplifies controlled development in a small field that was drilled conservatively and regulated by proration.

The Westbrook field is notable for its producing longevity despite the relatively low recovery per acre, and because it was the first field in West Texas in which oil was found in the Permian strata, previously regarded as nonproductive.

The studies in these fields are covered by Bureau of Mines Report of Investigations 3315, Petroleum Engineering Study of the Big Spring Field and Other Fields in West Texas and Southeastern New Mexico, by Charles B. Carpenter and H. B. Hill, published through coöperative assistance of the Midland, Texas, Chamber of Commerce. This report, containing 223 pages and 40 illustrations, and giving many valuable data concerning oil fields of the Permian Basin, is available from the Information Division, U. S. Bureau of Mines, Washington, D. C., or the Chamber of Commerce, Midland, Texas.

Greetings
To those whose good will helped to make 1936 a year of progress—a sincere and heartfelt "Thank you." To all oil men and their families—cordial wishes for a joyous Christmas season and a New Year of abundant health and happiness.
Gaso Pump & Burner Mfg. Co., Tulsa, Okla.
Export Office: 149 Broadway, New York
GASO PUMPS
for every oil industry need

Control of Galvanic Electrolysis on Large-Diameter Gas Lines

NEARLY all scientific discovery is the result of successful trial and error activity either in the laboratory or in the course of construction of new and untried methods of assembling a new combination of old elements. This activity always should be governed by a review of all the available data concerning the operations being engaged in. Quite often, therefore, we find that in attempting to bring about a desired result through one operation we uncover ways and means of accomplishing something entirely foreign to the work in hand.

Back in 1930 the Houston Pipe Line Company relaid a few miles of 16-in. line through an area of highly-corrosive soil and extremely short pipe life. At that time, it was thought that the best possible coating on a pipe line could be obtained by making that coating as thick as possible. Since it was impractical to apply several hot coats to pipe in the ditch, thereby attaining considerable thickness, it was decided to place a metal wrapper around the line and pour this full of hot asphalt.

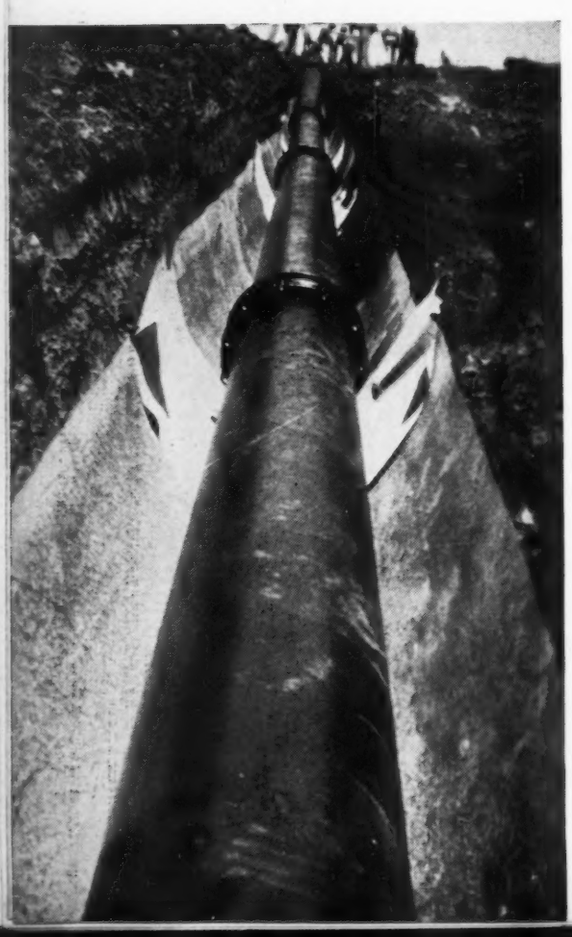


Fig. 1. Method used to wrap a half-mile section of pipe with 30-gauge galvanized iron

Fig. 1 illustrates the method used to wrap a half-mile section with 30-gauge galvanized iron, and Fig. 2 shows the method employed for filling up the wrapped sections with hot asphalt to an average thickness of approximately three inches. A very interesting observation at this point is to note in Fig. 1 that each galvanized sheet lapped the sheet immediately contiguous to it. In this manner a continuous metallic conductor one-half mile long was constructed around the pipe. It also will be noted from Fig. 2 that the galvanized iron was laced around the pipe and the couplings with iron wire. This latter served to bring about electrical contact between the sheeting and the pipe itself and thus bond the couplings, as well as bringing the whole section of pipe so treated to approximately the same electrical potential with respect to the soil in which it was laying. All these operations, however, were carried out not with a view to cathodically protecting the line, but in order to obtain a thick, heavy coat of asphalt around it and insulate it from the soil.

Four years later the corrosion department of this same company dug out one of these coated sections for examination purposes. No leaks had occurred, nor have any since developed on any of the sections so coated; however, the facts remain that as a coating job this method was very inefficient, since large areas under the bottom of the pipe were left uncoated, and the

Fig. 2. Method employed to fill the wrapped sections of pipe with hot asphalt

asphalt applied showed poor adhesion to the pipe and bad water absorption. At one particular location the whole bottom half of a coupling was found to be entirely devoid of any asphalt, yet it was in as good condition as when it was first laid in the line. It was concluded, therefore, that it was not the effective coating applied, but rather the cathodic protection afforded by the galvanized coating that had maintained this line in a perfect state of preservation.

Accordingly, a survey was made to determine what were the corrosive factors at work in this area and what was the nature of the electrical charge on the pipe. It was found that the galvanized coated section was from —.18 to —.25 volt negative to earth at all points, and that the steel pipe was at the same potential as the galvanized coating. It also was found that the pipe at either end of this coated area was highly positive to earth, and that numerous leaks had occurred and two sections of bad pipe equal in length to the coated section had resulted from this bad positive condition. It also was ascertained that there was no difference in the chemical nature of the soil or its electrical resistance in the cor-

An interesting experiment results in the obtaining of valuable data on this very important subject

By

DAVE HARRELL

Corrosion Engineer, Houston Pipe Line Co.

Fig. 3. Applying grease over the old asphalt paint

roded areas as compared with the coated area.

From this, it was reasoned that we had set up a big wet battery with plates a half-mile in length and of the same diameter as the pipe; that we had protected the center section at the expense of the sections on either end. We knew by experience that positive potentials such as we had created were very detrimental to steel pipe when they were allowed to exist in soils of low resistance and of a highly corrosive nature. We decided, therefore, that the only thing to do was to recondition the pipe on either end until a soil of high resistance and low corrosive action was encountered. This was done and the results seem to indicate that partial success was obtained. A change in the resistance of the soil has occurred, however, due to a tidal wave of salt water being thrown over it since the reconditioning.

Since the operation was such a success in this one area, it was decided to experiment with other areas. Accordingly, a section of bad pipe 600 ft. long was chosen at a point distantly removed from the first job. At this latter location the soil showed a decided change in ohm-centimeter resistance, as well as chemical concentration. We reasoned that no harm would result from the pipe at either end of the reconditioned area becoming positively charged to earth, since it lies in a soil of relatively high resistance.

This 600-ft. section was dug out in bell holes ranging from eight to ten ft. in length and of sufficient width that the coating and wrapping operation could be carried out rapidly. Since it was such a short job and of an experimental nature, the work was done by hand.

This was a very bad section of pipe and had caused the installation of many clamps both on the pipe and on the couplings, and it had been previously treated with three coats of cold asphalt paint the previous year. This asphalt now showed water absorption and poor adhesion so that it was decided to apply a coat of grease over the asphalt to render it more waterproof, as well as fill up some of the holes in the coating where it had blistered off the line. Fig. 3 illustrates the method of applying this grease over the old asphalt paint. This is in accordance with our leak-reconditioning procedure (see *The Petroleum Engineer*, October, 1936, p. 97) and served in some respects to assist the cold asphalt in remaining on the line.

Fig. 4 shows the method of tying the galvanized iron sheets in place with No. 14 galvanized iron wire. At this point we suddenly realized that we were going to have to take precautionary steps to enable us to find leaks, should any occur on this encased section. This was a very bad piece of pipe, and the company had no faith in additional leaks not appearing in a short time, due to changes in pressure if for no other reason. Should a leak occur under this galvanized iron, the tendency would be for the gas to follow the sheeting and it would be next to impossible to locate and repair the leak. Accordingly, holes were punched in the topside of the coating job at regular intervals as shown in Fig. 5.

Some difficulty was encountered in coating couplings, as shown in Fig. 6, and, in order to get a nice smooth job, it was found necessary to slit the galvanized wrapper with a pair of shears and then wrap the whole with wire on either end. The holes were then punched immediately above the coupling and the bell-hole backfilled. Prac-

Fig. 4. Tying the galvanized iron sheets in place with No. 14 galvanized iron wire

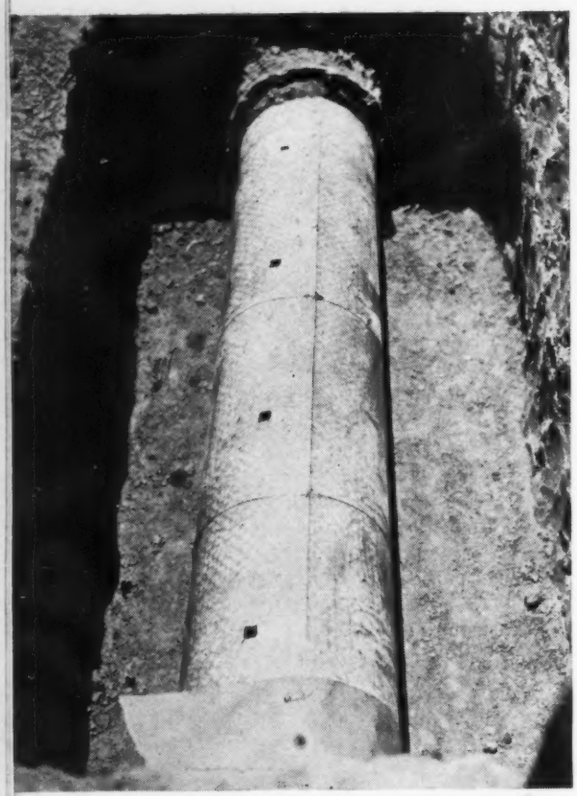


Fig. 5. Holes were punched in top-side of the coating job for gas to escape should a leak occur

tically the same operation was carried out in coating the numerous leak clamps on the line, as shown in Fig. 7, only in this instance greater trouble was encountered due to the irregular shape of the clamps and the various angles at which they were placed on the line.

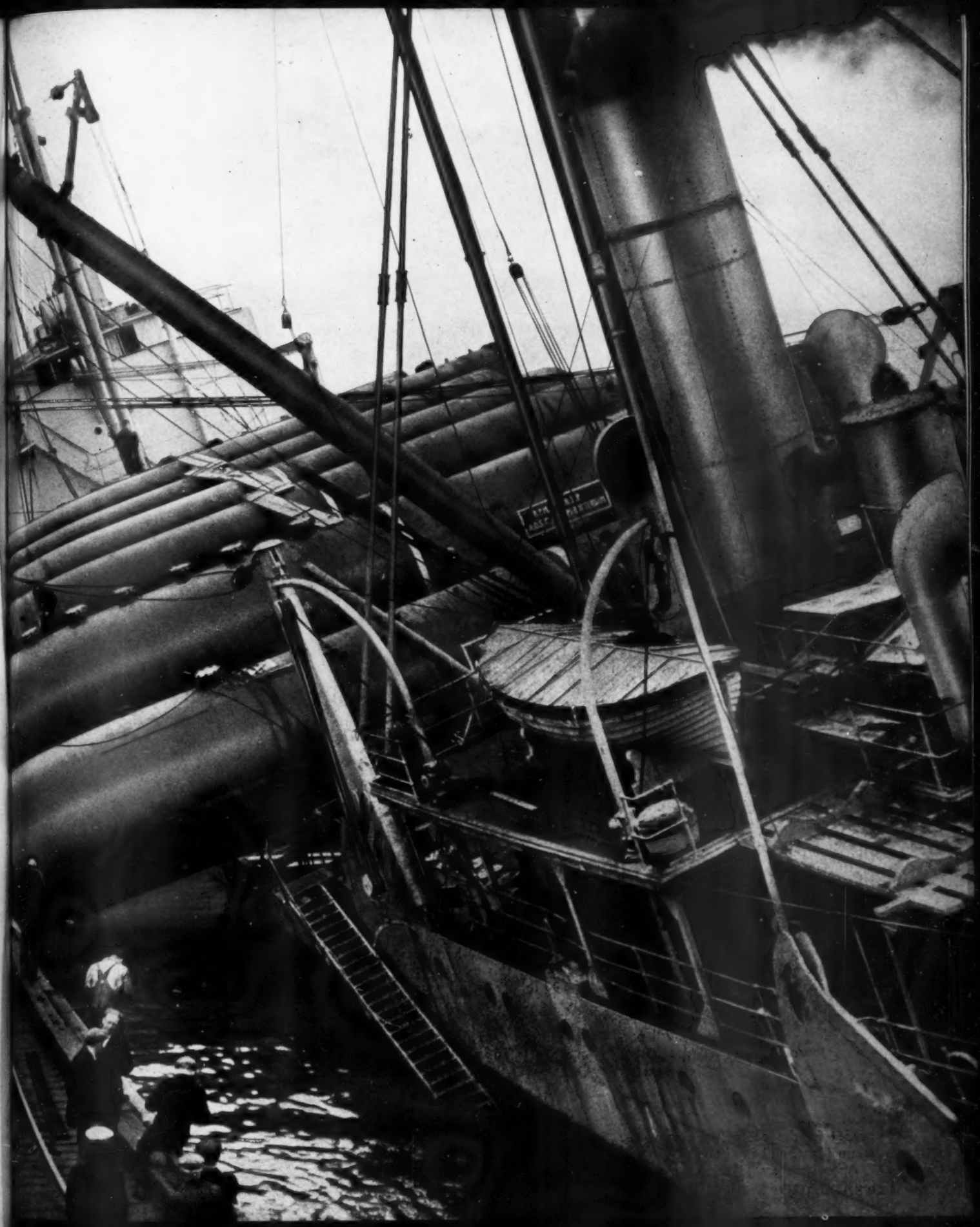
Since this was a live line it was necessary to dig it out in bell-holes, which were backfilled before the next section was uncovered, and it was found necessary to block under the line with timbers to eliminate settling from one bell-hole to the next. As each individual section was connected up and back-filled readings were made to determine the potential to earth, and it was found that this negative potential gradually increased from —.09 volt for a 30-ft. section completed to —.22 when the entire 600 ft. was completed.

This experimental job was completed in July, 1935, and no leaks have occurred either on the job or on the positive potential areas at either end. Fig. 8 shows the condition of the wrapper one year after it was placed in the ground. We found that it had lost some of its negative potential, as well as some of its zinc coating, but, on the whole, it was in good condition and showed signs of being a success. It is considered that not sufficient time has elapsed to enable the company to state definitely that this type of coating job has been entirely successful. Bell-holes are dug at regular intervals on the coated section, as well as the areas at the ends, to ascertain what changes, if any, are taking place. Thus far the soil resistance has remained very high, and although the positive areas have assumed potentials as high as .35 volt, no damage has occurred, since the soil has a resistance of 2500 ohms per cubic centimeter. An additional article will be written concerning this type of pipe line coating job as soon as sufficient time has elapsed to assure its success.

Fig. 7. Irregular shape of leak clamps and various angles at which they were placed made their coating and wrapping rather troublesome

Fig. 6. How a coupling looked after it was coated and wrapped

Fig. 8. Showing the condition of the wrapper one year after it was placed in the ground

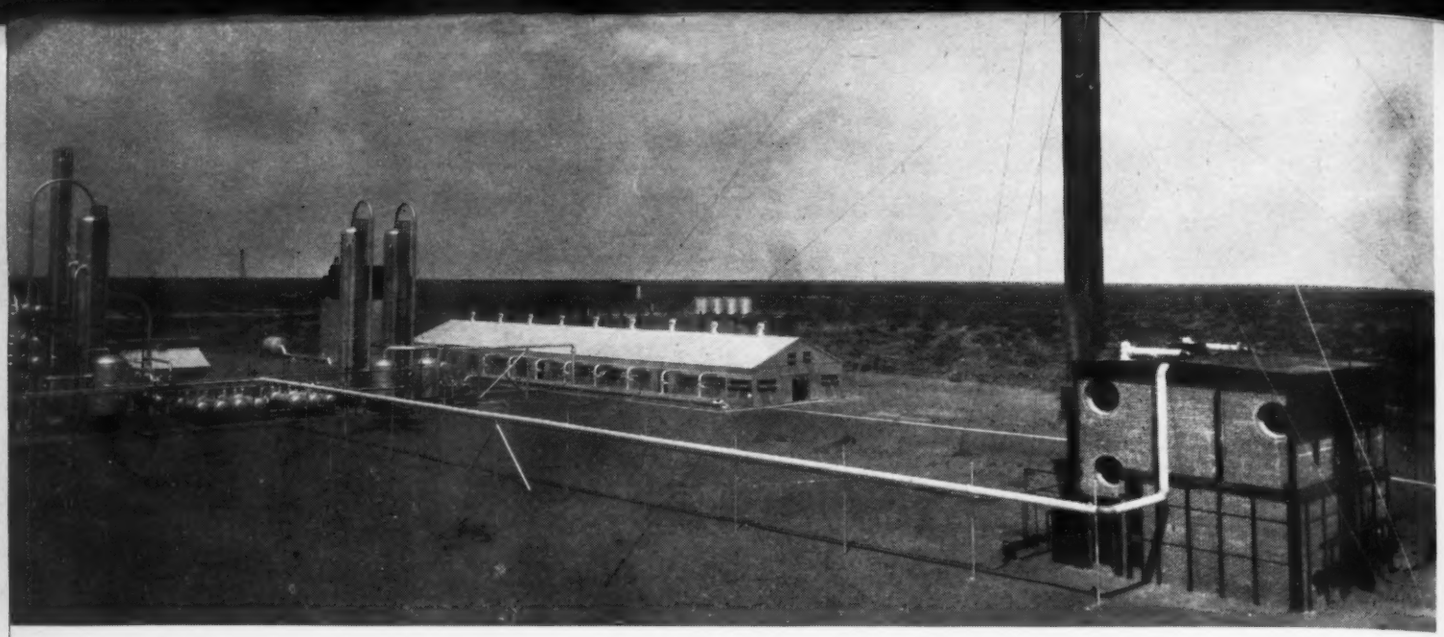


SMITH PRESSURE VESSELS

LINED OR UNLINED—ANY SIZE OR SHAPE WITHIN TRANSPORTATION LIMITS

MAKING STEEL WORK FOR YOU AS IT NEVER DID BEFORE IN—

SMITH LINE PIPE • SMITH PRESSURE VESSELS • SMITH HIGH-YIELD CASING



General view of Gulf Production Company's Monahans Gasoline Plant

Automatically-Controlled Absorption-Type Gasoline Plant Embodies Many Features

By FRANK H. LOVE

Installation of Gulf Production Company in West Texas handles 25,000,000 cu. ft. of gas daily at 30-lb. absorber pressure—Construction and operating details

AN automatically-controlled natural gasoline plant, modern in every respect with regard to equipment, design, and operating methods, was recently placed in operation by the Gulf Production Company seven miles northwest of Monahans in West Texas. Known as the Monahans gasoline plant, this unit, of the absorption type and capable of handling 25,000,000 cu. ft. of casinghead gas daily at 30-lb. absorber pressure, has numerous features of outstanding interest.

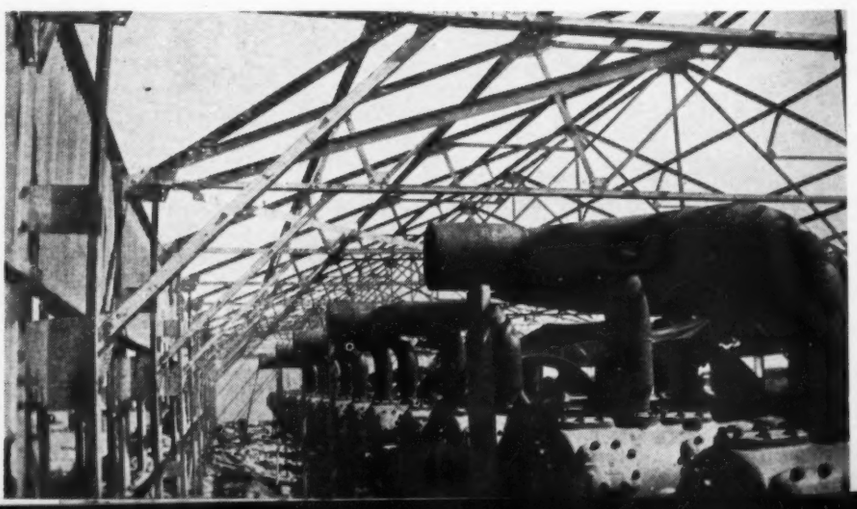
From the time the raw gas is received at the plant until the finished product is sent to the Monahans tank farm for blending a minimum operating personnel is required due to the automatic equipment employed. Automatic apparatus controlling the processing equipment is housed in a control room centrally situated with respect to the units it governs. All processing operations are handled from this station by the manipulation or setting of instruments, requiring for this purpose but one man for each tour. Other workmen, of course, are needed in the compressor room, the steam plant, and in the yard.

Approximately 13 miles of gathering lines, varying in size from 20-in. at the plant intake down to 10-in. in the field, where the system is connected to 100 wells, brings the gas to the plant at 5 in. of vacuum. Ten 230-hp. twin-cylinder direct-connected compressor units send the raw gas through two enclosed-type gas coolers to two 72-in. diameter, 20-tray, absorbers, the latter operating at a pressure of 30 lb. per sq. in. gauge. Upon leaving the absorbers a portion of the residue gas is utilized as fuel at the plant and on company production leases, a portion is burned in a flare, and approximately 12,000,000 cu. ft. is recompressed and sold commercially. Recompressors employed for the purpose are two 100-hp. units, boosting the gas in this instance to a pressure of 200 lb. per sq. in. gauge.

Oil circulation is maintained by two 8-in. centrifugal pumps driven by 50-hp. motors. Current for operating the motors is supplied by a generator driven by a 180-hp. gas engine. The normal oil circulation rate is 750,000 gal. per 24-hr. day. Fat oil from the absorbers is pumped through four heat exchangers of 30-in. diameter, thence through two preheaters of 22-in. diameter, and into the still, the latter being an 18-tray unit of 72-in. diameter. The still is operated at a pressure of approximately 36 lb. per sq. in. gauge in winter and 40 lb. in summer, and a temperature of 360 deg. fahr. maintained constant.

From the still the oil returns to the heat exchangers, and passes on through three lean oil coolers of 30-in. diameter, to the absorbers, completing the oil cycle.

Gasoline vapors removed from the fat oil in the still are carried through three enclosed condensers of 26-in. diameter and into an accumulator of 84-in. diameter and 10 ft. in height. The raw feed from the accumulator is



Showing the unusual arrangement of gas piping to and from the compressors

Greetings and Best Wishes from Oil Center Tool Company

TABLE I—ABSORPTION PLANT PERFORMANCE

GAS TO ABSORBERS—25,000,000 std. cu. ft./24 hr. at 35 lb./sq. in. gauge. Composition approximately as follows:

Component	*Mol Percent*
CO_2	0.2
Methane	83.6
Ethane	6.5
Propane	3.8
Butane	3.2
Pentane plus	2.7
	100.00

LEAN-OIL CIRCULATION—750,000 gal./24 hr., 40-A.P.I. gravity, 175 mol. wt., 370 IBP, 450 EP.

RAW GASOLINE—About 32,500 gal./24 hr.

RECYCLE GAS—From still-accumulator about 350,000 std. cu. ft./24 hr.

PENTANE RECOVERY—99.8 percent of pentane in gas.

BUTANE RECOVERY—53 percent of butane in gas. Required to produce 26-70 finished gasoline.

NORMAL OPERATING TEMPERATURES:

Lean oil to absorbers	80 deg. fahr.
Fat oil from absorbers	90 deg. fahr.
Fat oil to preheater	295 deg. fahr.
Fat oil to still	360 deg. fahr.
Vapors to condensers	180 deg. fahr.
Condensate from condensers	80 deg. fahr.
Lean oil from still	345 deg. fahr.
Lean oil to coolers	140 deg. fahr.
Gas to absorbers	85 deg. fahr.
Cooling water	75 deg. fahr.
Water from lean-oil coolers	115 deg. fahr.
Water from condensers	100 deg. fahr.
Water from gas coolers	90 deg. fahr.

NORMAL OPERATING PRESSURES:

Absorbers	30 lb./sq. in. gauge
Still	36-40 lb./sq. in. gauge

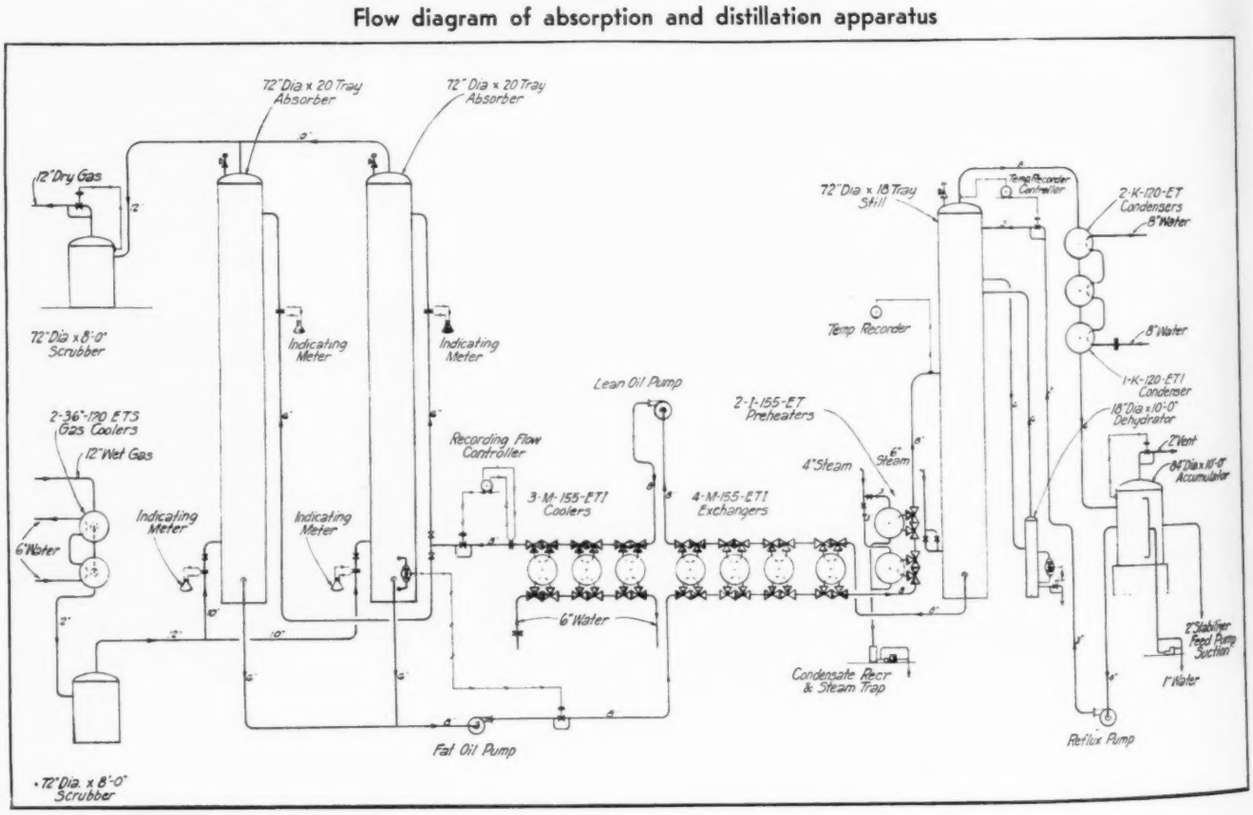
pumped to the stabilizer tower by a centrifugal pump driven by a 10-hp. motor. This stabilizer is of 30-in. diameter and has 30 trays, being of the latest design and capable of producing gasoline of 12-lb. vapor tension or above. At present an 18-lb. vapor-tension gasoline is being manufactured. The maximum capacity of the stabilizer is 38,000 gal. daily.

The finished gasoline is sent to storage, consisting of three 10-ft. diameter by 40-ft. horizontal steel tanks, and three 10-ft. diameter by 30-ft. horizontal tanks. From there it is delivered by pipe line to the Monahans tank farm where it is blended with crude oil in proportions of ten percent gasoline to 90 percent crude oil, this blend being pumped to the Sweetwater, Texas, refinery of the company.

More detailed information concerning operating temperatures, pressures, etc., of the absorption plant and stabilizer unit is given in Tables 1 and 2.

Though this completes the description of the principal processing cycles, other equipment contributing vitally to the operation of the plant are well worthy of consideration. Among these features is the unit that provides steam. Two 358-hp. horizontal water-tube boilers are employed for this purpose, each capable of producing 24,000 lb. of dry steam per hour, sufficient to operate the plant at its maximum requirement. The boilers are totally enclosed in brick settings that do not require a building to house them. Draught is provided by a single steel stack 130 ft. high and 54 in. in diameter. The boilers have air-cooled walls, and all air mixed with the gas going to the burners is pulled around the walls and under the fire box by

Flow diagram of absorption and distillation apparatus



Here's Your Complete file of LANE-WELLS Gun Perforator Applications!

SEND TODAY FOR YOUR *FREE* FILE OF GUN PERFORATOR APPLICATIONS.

"Perforating Pete" Says:

"For the past year I've been explaining applications of the Lane-Wells Gun Perforator Service. To date I have thoroughly discussed ten most important ones together with explanatory diagrams. Feeling that every oil man should have a file of these applications to help solve a few of his problems, I have arranged to have this series of Gun Perforator Uses reprinted and bound into a convenient file folder for easy reference. This complete file folder is yours for the asking. Just fill in the attached coupon and it will be sent you without obligation whatsoever. I know you will find it A BIG HELP!"

How about . . .

Abandoning Wells?
Cementing Blank Liners?
Cement "Squeeze" Jobs?
High Pressure Strata?
Test for Water Shutoff?
Better Acid Treatment?
A Cratering Well?
Clogged Screens?
Low Gas/Oil Ratios?

. . . these questions are thoroughly discussed in this Free File Folder . . . Send for it TODAY!

Tomorrow's Tools Today!

THE **LANE-WELLS** CO.
Gun Perforator Service
LOS ANGELES, CALIFORNIA ○ NEW YORK CITY, NEW YORK

THE LANE-WELLS CO. OF TEXAS • HOUSTON & CORPUS CHRISTI • THE LANE-WELLS CO. OF OKLAHOMA • OKLAHOMA CITY & TULSA

"PERFORATING PETE," c/o Lane-Wells Co.
5610 So. Soto St., Los Angeles, Calif.
Without obligation send me Gun Perforator Applications.

NAME_____
ADDRESS_____
CITY_____ STATE_____

TABLE 2—STABILIZER PERFORMANCE

FEED	32,500 gal./24 hr. of 105-A.P.I. raw gasoline
BOTTOMS	30,500 gal./24 hr. of 26-70 gasoline.
OVERHEAD	80,000 std. cu. ft./24 hr. fixed gas.
REFLUX	32,500 gal./24 hr. of 140-A.P.I. reflux.

NORMAL OPERATING TEMPERATURES:

Feed to exchanger	80 deg. fahr.
Feed to column	225 deg. fahr.
Overhead from column	120 deg. fahr.
Overhead from condensers	110 deg. fahr.
Column bottoms	285 deg. fahr.
Bottoms from exchanger	140 deg. fahr.
Bottoms from cooler	80 deg. fahr.
Water to plant	75 deg. fahr.
Water from condensers	100 deg. fahr.
Water from cooler	100 deg. fahr.

NORMAL OPERATING PRESSURE—250 lb./sq. in. gauge.

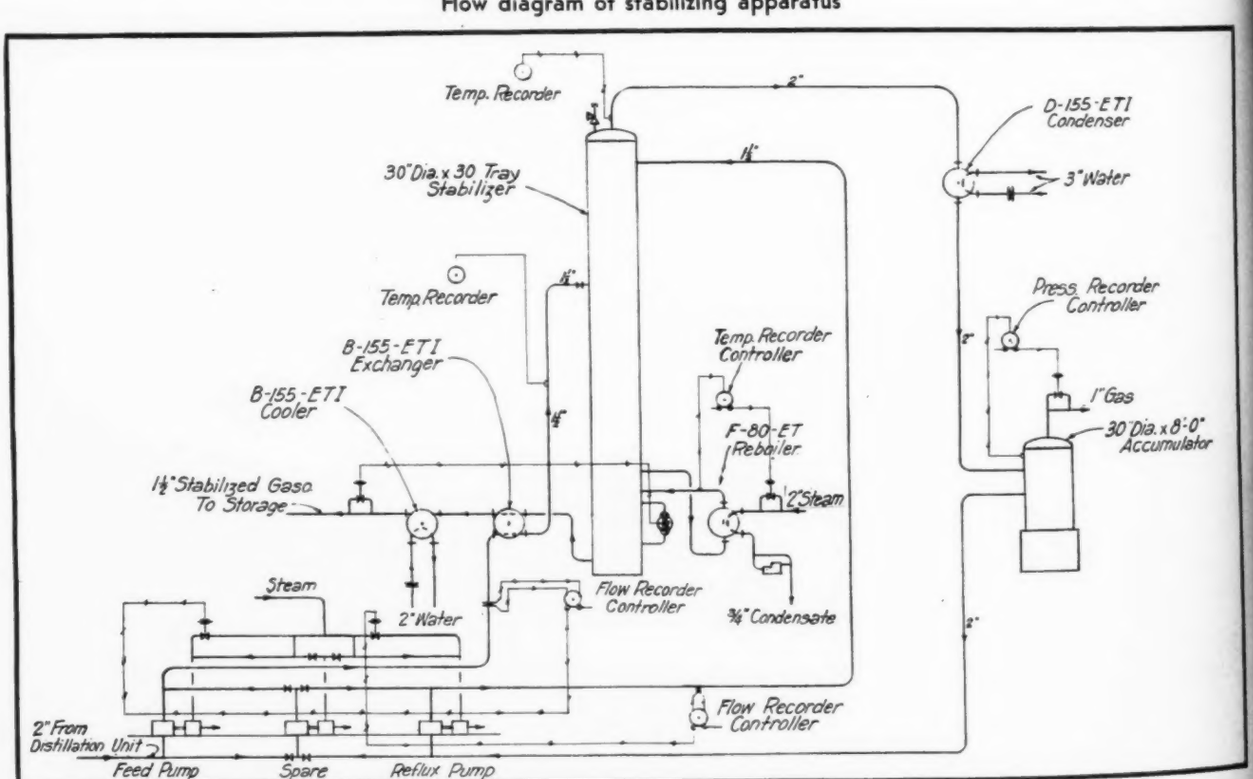
the stack draught, keeping the walls cool and preventing cracking of the setting. The boilers obtain water from the main storage supply. Steam generated by this unit is utilized for driving the steam turbine that circulates cooling water at a pressure of 170 pounds. Discharge steam from the turbine is run directly to the still at a pressure of 40 lb., and additional live steam is admitted to the stills when necessary for the complete stripping of fat oil, the latter supply being obtained directly from the steam plant. Live steam also is used for heating the oil in the preheaters to a temperature of approximately 360 deg. fahrenheit. After serving its purpose in the preheaters the steam is returned to a feed-water heater. This steam, condensed, as well as that from the still, goes to the hot well, whence it is picked up and fed to the boilers when needed. All water prior to entering the boilers is raised to a temperature of 200 deg. fahr. by the feed-water heater.

Water for cooling purposes is supplied by four 350-ft. water wells drilled on the plant site. Each is capable of producing 1000 bbl. of water daily. The water thus obtained is somewhat hard and is treated with soda ash and lime until the permanent hardness is nil. Employed in the water-treating process are four 1500-bbl. tanks into which the water is pumped. After treatment, the water leaves the tanks by gravity and goes to the hot well, where it is picked up by an 8-in. centrifugal pump driven by motor and boosted to a 5000-bbl. storage tank that supplies cooling water for the engines and various other equipment. For cooling the water a 12-bay cooling tower 70 ft. in length, having a capacity of 2000 gal. per minute, is provided. Processing water is pumped by a steam-turbine-driven centrifugal unit, which has a 12-in. suction and 10-in. discharge. There are two of these pumping units (one being used as a standby), each having a capacity of 2400 gal. per minute.

Total water consumption for the plant, including circulating water for the engines, boiler-feed water, and circulating water for the condensing equipment, varies from 1500 bbl. daily in winter to 3000 bbl. daily in summer.

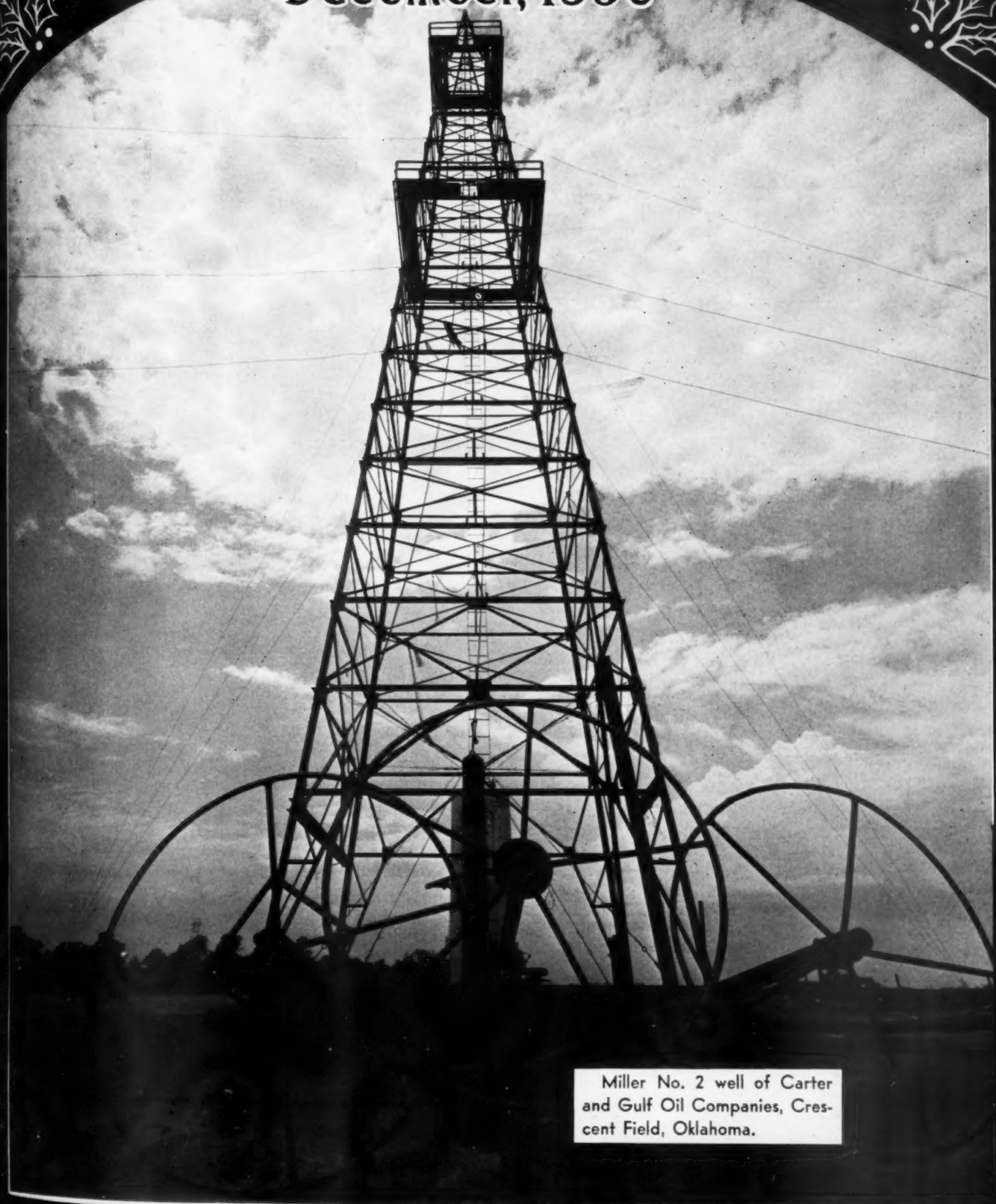
In arranging the gas piping to and from the compressors a rather unique departure, with respect to usual practice, was made. All connections were welded, and the suction connection from the main 20-in. header, which is above ground, is overhead, branching through a welded wye to each of the two cylinders of the twin compressor units. The discharge likewise is a welded wye connection coming from each cylinder into a single line underneath and terminating in a 20-in. discharge header, also above ground, and thence is carried overhead to the absorbers.

Flow diagram of stabilizing apparatus



Pictorial Petroleum

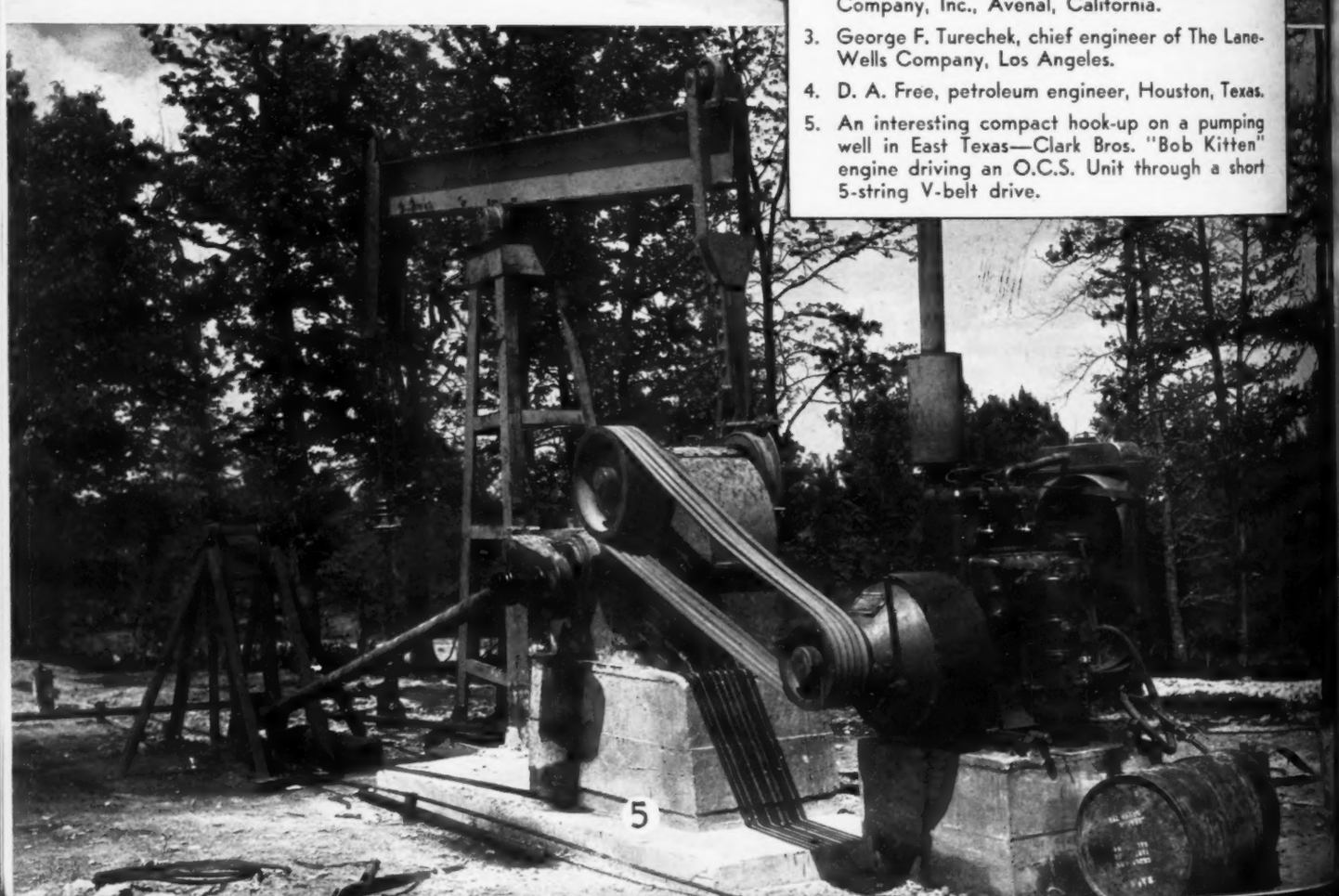
December, 1936



Miller No. 2 well of Carter and Gulf Oil Companies, Crescent Field, Oklahoma.

A REGULAR FEATURE OF THE PETROLEUM ENGINEER

1. An oil drilling operation near Sullivan, Texas, that is completely "Caterpillar" powered. A D13000 Power Unit is connected to a Sheldon-Burden drawworks, a D11000 operates a Gardner-Denver 6¾x14-in. mud pump, and a D8800 powers the generator for the lights.
2. J. E. Brantly, president, Drilling & Exploration Company, Inc., Avenal, California.
3. George F. Turechek, chief engineer of The Lane-Wells Company, Los Angeles.
4. D. A. Free, petroleum engineer, Houston, Texas.
5. An interesting compact hook-up on a pumping well in East Texas—Clark Bros. "Bob Kitten" engine driving an O.C.S. Unit through a short 5-string V-belt drive.



HYDRIL

The ONLY Drill Pipe Joint that embodies ALL of these important features!

1 The hole through the Tool Joint is THE SAME SIZE AS THE FULL INSIDE DIAMETER OF THE PIPE. This joint provides the largest circulation passage obtainable in ALL sizes of drill pipe, from 2⅜-inch up.

2 This beveled shoulder locks the tool joint securely in the drill pipe and defies creep—the tool joints never have to be welded to the pip A similar shoulder on the other end of the tool joint forms a leakproof outside fluid seal and solid shoulder at the working thread.

3 Strong one-piece tool joint made of selected steel and heat-treated for maximum strength and long-wearing quality.

4 The exclusive Hydril double-step thread is wide at the crest, resists battering and wear. Screws up easily, without galling. Extra strong because more metal is placed in shear, and the double-step feature provides more metal at the base of the pin and inside of the box.

5 WIDE OPEN fluid passage through the entire length of drill pipe.
All manufacturers of seamless drill pipe make pipe for the Hydril Internal Flush Joint.

6 EXTRA STRENGTH at the thread in the pipe. Elevator manufacturers make elevators to fit the upset of this joint.

7 This tapered seat insures a tight inside fluid seal, preventing erosion of the joint and threads due to leakage of the drilling fluid under high pressure.

8 No restrictions, off-sets or reliefs in the fluid passage to cause eddy-currents and sand cutting of the pipe or tool joint.

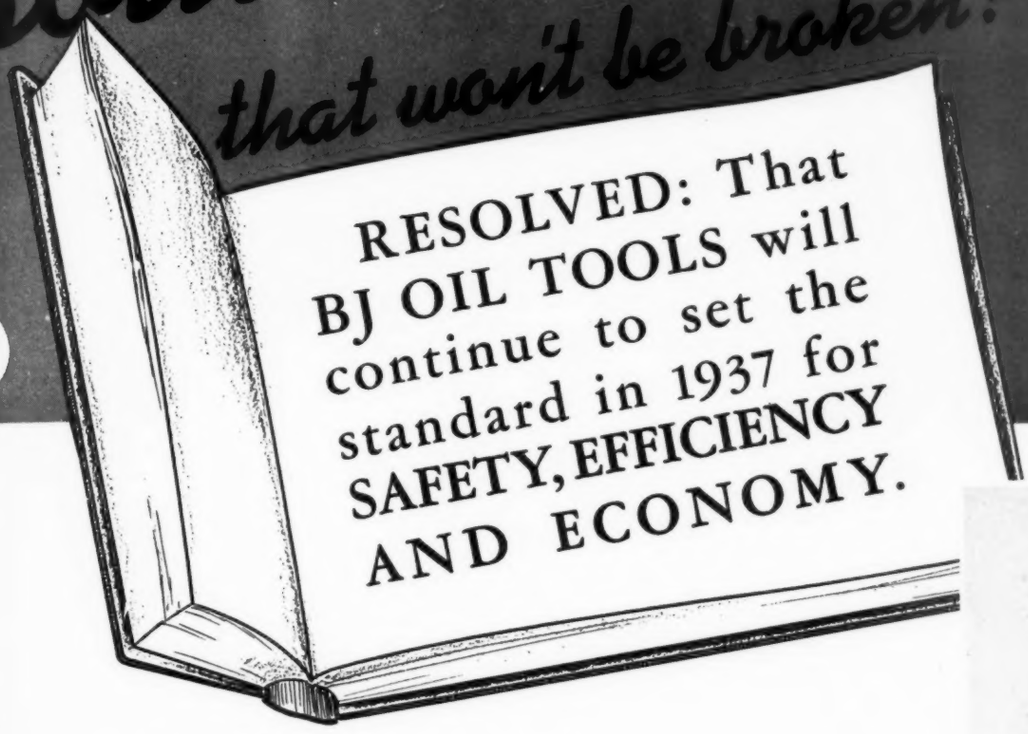
9 The threads are cut in the pipe and the tool joints are made at the Hydril plants at Torrance, California, and Houston, Texas.

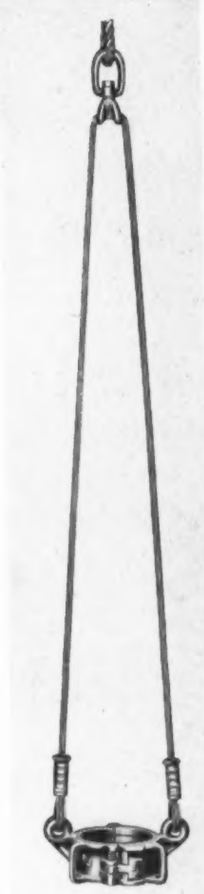
See your 1936 COMPOSITE CATALOG or write for complete data concerning this and other Hydril Products.

7[illegible] West Olympic Boulevard • Los Angeles
4[illegible] Calhoun Road • Houston, Texas
Cable Address "HYDRIL"

1. This plant of the Natural Gasoline Corporation has been in operation for about 11 months, and has processed up to 50 million feet of gas daily.
2. Clarence R. Mazey, independent operator, Billings, Montana.
3. E. Fullmer (left), superintendent of the Standard gasoline plant, and T. K. Sloan, gas engineer for the Standard at Taft, California.
4. Joe E. Sink of the W-K-M Company, Houston, Texas, upon his return from a hunting trip to that company's lease ten miles southwest of Fredericksburg, Texas.
5. Smith Brothers recently completed this 40 million ft. natural gasoline plant in the Sayre Pool near Kermit, Texas.

Resolutions AND TOOLS that won't be broken!





Why don't you **start the New Year right by resolving to protect your well and equipment with that EXTRA measure of safety and economy afforded by BJ Drilling and Production Tools?**

BJ TRIPLEX HOOKS

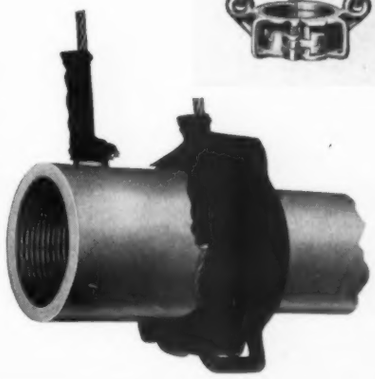
The modern hook for oil well drilling—made in two sizes for 150 and 300-ton loads. The larger lower hook carries the swivel bail in a centrally balanced position; each of the two upper hooks holds one of the elevator links. Eliminates off-center strains. The locking arms form a C-link effect which increases strength and prevents swivel bail or links from "jumping" the hook.

BJ TYPE "G" ELEVATOR FOR EXTERNAL UPSET DRILL PIPE

Handles External Upset Drill Pipe safely without using lifting plugs. It supports and lifts the pipe by the external upset and its rugged construction permits carrying the longest strings with highest factor of safety.

BJ TYPE "J" SINGLE JOINT ELEVATOR

This elevator is attached with a wire line or Manila rope to the hook or to the large elevator and while the string is being made-up, it is closed around the next joint of casing to be "tailed-in" the derrick. Eliminates danger of slipping which frequently occurs when a rope sling is used, resulting in many accidents. Suspends the joint of casing in vertical position for making-up easily. Amply strong to lift one joint of the largest size casing, the Type "J" Elevator swivels easily, hangs true and is light and easy to handle.



THE AMERICAN PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

BYRON JACKSON CO.
AND SUBSIDIARY
FORT WORTH • LOS ANGELES • NEW YORK

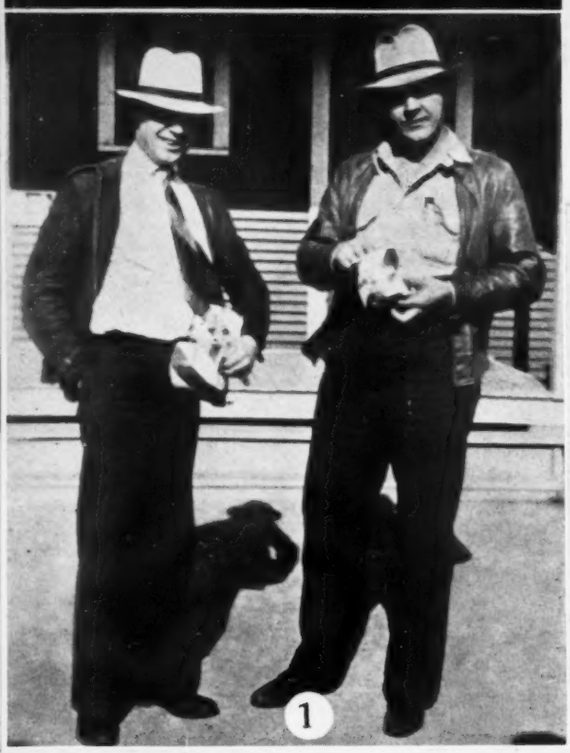
Refer to the BJ Catalog or the BJ section of the Composite Catalog for technical descriptions, operating details and prices; or write to our nearest office.

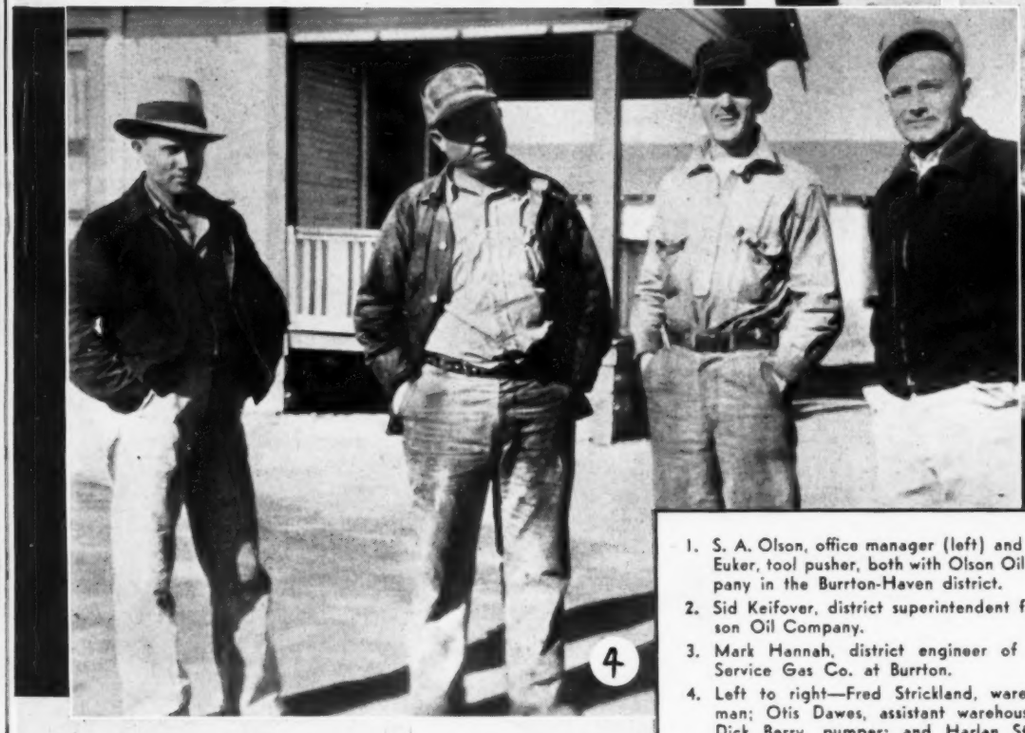
BJ DRILLING & PRODUCTION TOOLS

Safe-Efficient-Economical

GROUP of KANSAS FIELD MEN

Photographs courtesy of A. D. Watson, with Tretolite Company at Hutchinson, Kansas.





1. S. A. Olson, office manager (left) and Eddie Euker, tool pusher, both with Olson Oil Company in the Burrton-Haven district.
2. Sid Keifover, district superintendent for Olson Oil Company.
3. Mark Hannah, district engineer of Cities Service Gas Co. at Burrton.
4. Left to right—Fred Strickland, warehouseman; Otis Dawes, assistant warehouseman; Dick Berry, pumper; and Harlan Stagner, district foreman; for Sinclair-Prairie Oil & Gas Co., Haven.
5. Pat Talbot, gauger for Skelly Oil Company, Haven.
6. R. E. Smith, district foreman for Sinclair-Prairie Oil & Gas Company in the Voshell-Hollow district, McPherson.
7. Plant of Hall-Scott Company, manufacturers of gas and Diesel engines, Los Angeles.

5 YEARS' PERIENCE BEHIND IT!

1 YEAR'S ACCEPTANCE OF IT!

this INSIDE CUTTER,

that operates by *FRICTION* alone,

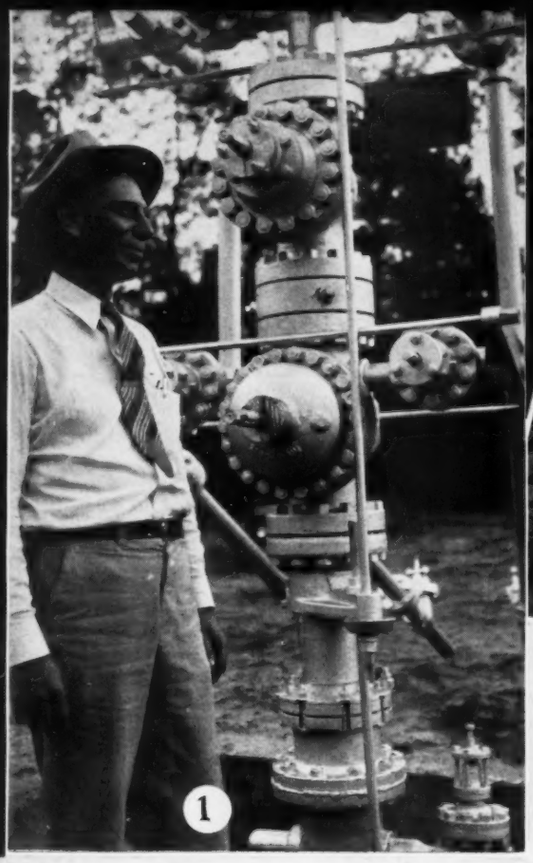
places

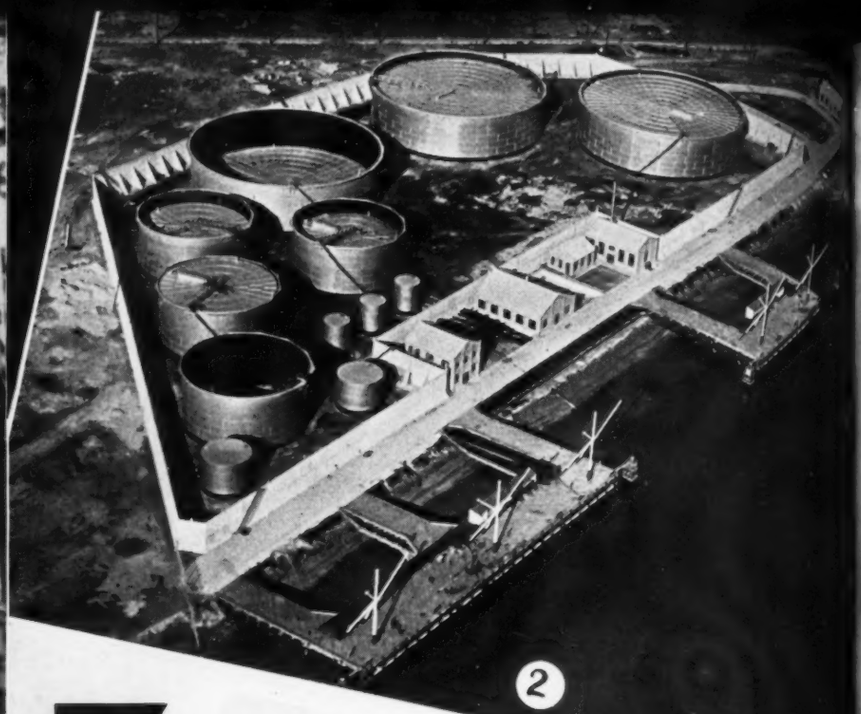
RED BALL

STILL FURTHER AHEAD OF THE FIELD!

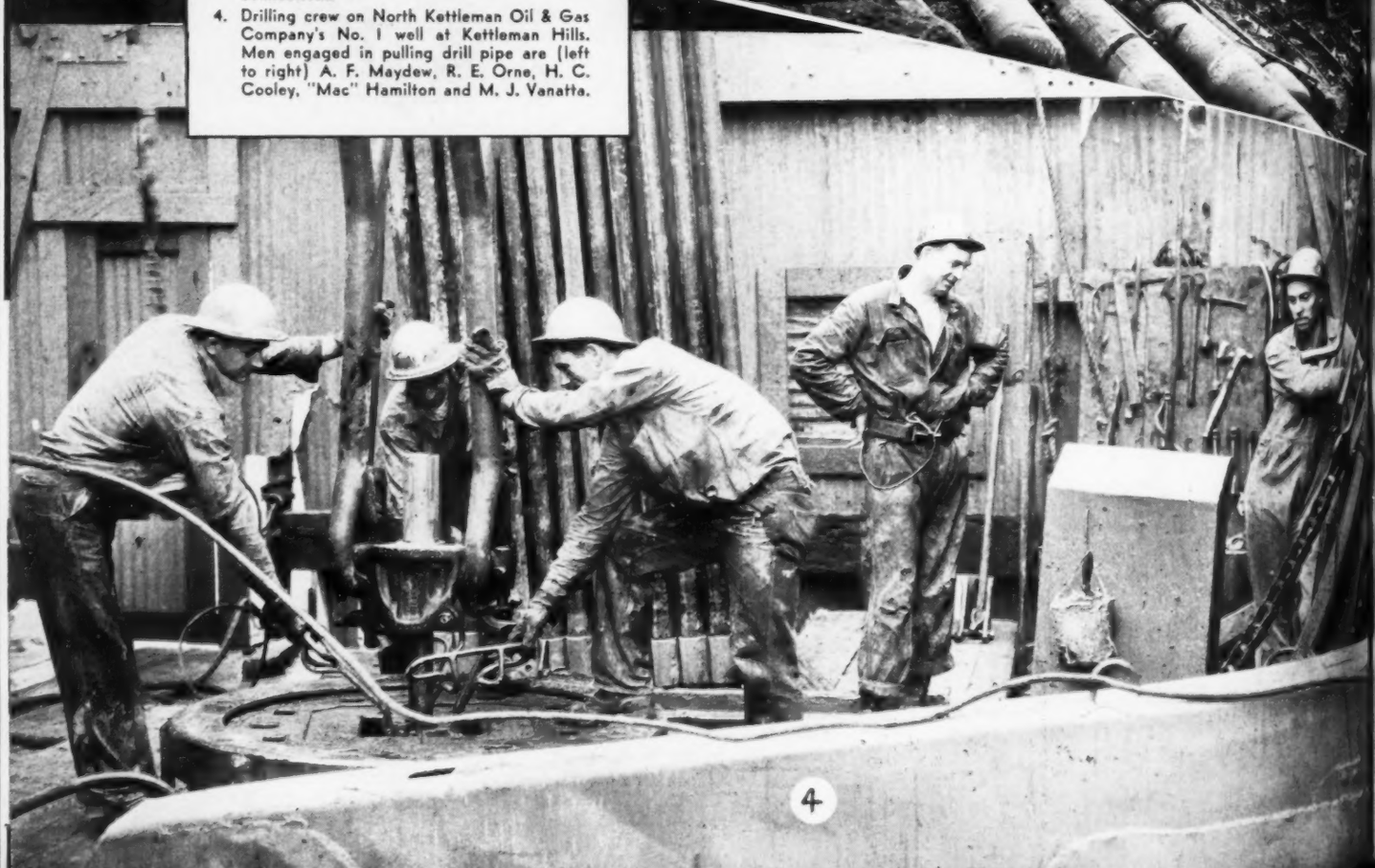
Three friction rollers contact the inside of the pipe. Right-hand rotation gradually feeds the blade out by continuous friction of rollers contacting the beveled friction rings which are splined to the shaft. The shaft in turn drives the eccentric bottom of the shaft that is pinned to the cutter blade. A clutch type Releasing Spear run above the cutting tool permits cutting and pulling in a single operation, thus reducing the number of round trips.

This Improved Cutter gives RED BALL SERVICE the same leading position on inside pipe jobs it has held for 15 years on outside cutting.





1. Emmett Heath of Gray Tool Co. beside an installation of the Gray Kerotest Master Control Christmas Tree on R. W. Norton well at Rodessa, Louisiana.
2. Loading dock of the Rio Grande Oil Company at Long Beach Harbor, California.
3. Section of Phillips Petroleum Company's Mansion compressor station under construction. It has 13 Clark Bros. "Super-2's." View shows arrangement of headers and intake connections.
4. Drilling crew on North Kettleman Oil & Gas Company's No. 1 well at Kettleman Hills. Men engaged in pulling drill pipe are (left to right) A. F. Maydew, R. E. Orne, H. C. Cooley, "Mac" Hamilton and M. J. Vanatta.

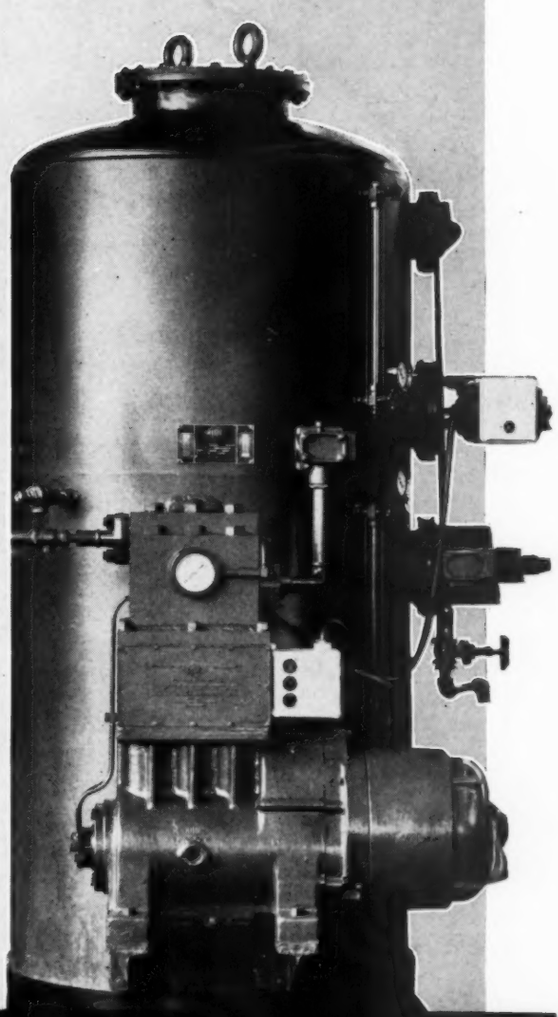


Lower MAINTENANCE COSTS . .

Accurate records of Kobe Pumps in service over a period of years and under widely varying conditions have shown important improvements in production, performance, efficiencies, and economies as compared to previous methods. Not the least important among the economies effected is that of reduced maintenance cost.

On the basis of past performance, Kobe is enabled to offer users of the Kobe method a definite and complete maintenance service in consideration of the payment of a flat sum per year. This plan assures the user, (1) a definitely lower maintenance cost per year, and (2) advance knowledge of exactly what that maintenance cost will be.

The Kobe All-Purpose Pump is adapted to practically all field, well and operating conditions and provides operators with many advantages in addition to higher efficiencies and greater economies in operation. Kobe engineers are available at all times to supply detailed data relative to these advantages, and for working out individual production problems, without obligation.



KOBE, INCORPORATED
(Pronounced KOB)

Manufacturers of KOBE Heat-Treated Screen Casing and KOBE Pump
3040 EAST SLAUSON AVENUE
HUNTINGTON PARK - - - - CALIFORNIA, U.S.A.

This important refining process is discussed in detail by the writer, who explains the various methods employed and describes the apparatus used, giving, as well, results of his original research work

Extraction of Paraffin Wax from Crude Oil

By R. FUSSTEIG

PARAFFIN wax, one of the most valuable products obtainable from crude oil, was first discovered in the year 1830, when Reichenbach established it by means of a microscope as a solid structure in a cooled alcoholic solution of a crude oil. Reichenbach published these observations in the same year, but they showed a scientific value only in the early years. With the development of the chemical industry this discovery became a most important one to the oil refining industry.

The chief purpose became to separate this paraffin wax from the oil; however, considerable trouble was experienced, due to the fact that the boiling range of the paraffin wax is quite similar to that of lubricating oils. These observations led to the conclusion that separation of the wax from the lubricating oils by means of the distillation process is a difficult matter; therefore, another method of procedure has been adopted. It has been found that the paraffin wax may be separated from the oil when the latter is cooled under proper conditions. In this process the paraffin wax particles crystallize, and may be filtered through the wax presses; but even this method has given trouble.

One of the major difficulties is the production of the proper type of paraffin wax crystals, so that they can be filtered rapidly through the wax presses. In the early days of the development of the industry there was a belief that paraffin wax was obtainable in two forms of crystals: (1) amorphous, and (2) those having a crystalline structure. According to that belief, the amorphous form was found only in crude oil. It was believed that only by the distillation process could the amorphous form be transformed into the crystalline structure; therefore, those filter-press characteristics of the wax distillate were improved by a so-called cracking distillation process. The wax distillate was heated to approximately 800 deg. fahr. and a certain amount of decomposition occurred.

Zaloziecki[1] was the first to find the presence of crystalline paraffin-wax particles along with amorphous paraffin wax. In order to prove the correctness of these observations, Zaloziecki has taken into consideration a salve-like residue of a crude oil from Klenczany, treating it — but using no distillation—five times with amylic alcohol; that is to say, he extracted certain higher molecular hydrocarbons by means of amylic alcohol. As a result of these investigations he obtained a crystalline paraffin wax with a melting point of 59 deg. centigrade.

According to these results, he believed that certain unknown higher molecular hydrocarbons prevent the crystallization of the paraffin-wax particles when dissolving in the crude oil; moreover, as already mentioned, he believed in the simultaneous presence in the crude oil of amorphous paraffin wax whose chemical structure differs entirely from those of crystalline paraffins. According to his opinion, the crystalline paraffins are normal hydrocarbons, but the amorphous paraffins show the structure of iso-hydrocarbons; furthermore, he proved that only the cracking distillation process is able to transform the amorphous structure into the normal hydrocarbons; that is, into paraffin-wax crystals.

This cracking distillation process also destroyed the inhibitors of tar and resin-like ingredients, resulting in the lowering of the viscosity of the mother liquid. In other words, two factors improved the crystallization and facilitated filtering through presses: the removal of the inhibitors, and dilution of the mother liquid. Today this method is not employed, because of certain disadvantages. It causes the simultaneous decomposition of the higher melting paraffin waxes into lower melting hydrocarbons and gas; moreover, the decomposition of the mother liquid deteriorates its oiliness, renders impossible the production of high quality lubricating oils.

The theory of Zaloziecki was uncontested for a long time, but recent investigators have proved the incorrectness of this theory. Jones and Bleachly[2] have established that some crystallization inhibitor is adsorbed on the surface of the minute wax particles, increasing their surface tension. This causes them to become surrounded by a protective film of oil that prevents the ready growth of the crystals. The same investigators have found that the tar and resin substances act as inhibitors.

A method that removes these inhibitors from the crude oil is pipe-still distillation. Here an exact fractionation between hydrocarbons and inhibitors of tarry or resin-like nature is accomplished. The inhibitors are condensed in the bottom of the fractionating tower, while the paraffin-wax distillate leaves the tower as vapors, being condensed in a water-cooled condenser. This method may be considered as a highly economic process, because of a high yield of high quality paraffin wax and lubricating oils.

This process, however, encountered other difficulties. The mother liquid of the paraffin-wax distillate obtained in this process showed a high viscosity, and in consequence rendered impossible the crystallization of the paraffin-wax particles. The fraction over 0.895 sp. gravity at 15 deg. cent. especially gives considerable trouble in the matter of separation of paraffin wax from oils. The viscosity of the mother liquid is found to influence the size of the crystals; that is, the more viscous the liquid the smaller the crystals. Of course, the velocity and time of cooling also influence the size of crystals. The more rapid the rate of cooling of a given wax distillate the smaller the crystals obtained. Again, the more concentrated the solution of paraffin wax the smaller the crystals.

The dilution of a highly viscous wax distillate in gasoline causes the crystallization of paraffin-wax particles, but this cooled material also gives a great deal of trouble in the separation of paraffin-wax. The success of filter-pressing depends not only upon the growth of crystals, but also upon the form of crystallization. Preferably they should be in the form of needles rather than plates, because the former results in a more porous cake through which the oil filters more readily. The highly viscous wax distillate diluted with gasoline shows a growth of plates, but the growth being very compact, the oil runs out slowly when the wax distillate is pressed.

Viewing this process in the light of the above we are forced to the conclusion that when the paraffin wax is crystallized out as needle-like crystals, they do not lie as compactly as the plate-like crystals. In the heavy wax distillate, obtained by means of the pipe still distillation, the high viscosity of the mother liquid is the cause of poor crystallization. In order to increase the growth of crystals in heavy wax distillates many refineries use concentrated sulphuric acid.

This process destroys certain higher molecular hydrocarbons, consequently lowers the viscosity and leads to a better crystallization. This refining process encounters other disadvantages, however. The oiliness of the mother liquid is lowered, reducing the quality of the lubricating oil. In addition, it has been found as a result of microscopic investigation that this refining process is unable to transform all paraffin-wax particles into needle-like crystals. According to the writer's investigations, the heavy wax distillate contains certain highly complicated hydrocarbons that prevent the transformation of the plates into needle-like crystals. A paraffin-wax particle in a heavy wax distillate is surrounded by two protective films, the first exterior film containing a tarry or resin-like substance, while the second interior film, which is in direct contact with the paraffin-wax particle, consists of certain highly viscous hydrocarbons.

When a wax particle is surrounded by these two films the particle, due to their high surface tension, is in the amorphous form. Removal of the first film decreases the tension to a certain degree, resulting in the growth of crystals in plate form. The extraction of the second film causes the complete disappearance of the surface tension, permitting the paraffin-wax particles to crystallize as needles.

It was necessary therefore to find a new method that not only would remove the first protective film, but also transform by the use of a proper solvent the second film into a complex compound. This complex dilution must have no influence on the surface of the paraffin-wax particle. Before discussing this matter it is desirable to review briefly the beginning of the dewaxing process.

The practical preparation of paraffin wax from wax distillate divides itself into the following processes: (1), chilling out the wax, followed by its separation from the crystal mass by filter-pressing; (2), de-oiling of the pasty mass by fractional melting at slightly elevated temperatures, and pressing at above normal temperatures; (3), removal of oil from scale wax (obtained in (2) by warm pressing) by sweating. This latter is the part of the processing from which various commercial paraffin waxes are obtained; (4), refining of the crude wax with acid followed by clay-bleaching.

The first and second processes are in reality only preliminary steps and the fourth is a final purification procedure. The most important of the four is the sweating process, since, according to the present known art of paraffin manufacture, it is here that the real separation of the various commercial grades of paraffin wax is accomplished. This process depends to a high degree upon the run of the first and second phase. If the paraffin-wax distillate presents a low viscosity, and is free from inhibitors that prevent the formation of needle-like crystals, it will be, of course, easily cooled, crystallized, filtered, and sweated. Should the wax distillate have a higher viscosity, the dewaxing process encounters other difficulties. It is desirable, therefore, to fractionate the wax distillate during the distillation process of the crude oil into three cuts: the first cut 0.850-0.870 sp. gravity at 15 deg. cent. shows a low viscosity and is free of all inhibitors. It is an ideal material therefore for an easy dewaxing process. The other two cuts, however, behave differently. The second cut, 0.870-0.895 sp. gravity at 15 deg. cent. shows a high viscosity, which causes the paraffin-wax particles to crystallize into plates. It can be cooled, crystallized, and pressed, but the sweating process presents great difficulties, because only needle crystals can be separated easily from the oil. The third cut presents an extraordinarily high viscosity, and possesses a certain quantity of inhibitors of tar and resinous substances, forcing the paraffin-wax particles to remain in the amorphous form so that it can be neither pressed nor sweated.

These various crystallizations of the cuts show that each must be treated differently. As mentioned, the first fraction can be dewaxed readily, but the second and third fractions present a difficult operation, because they are unable to form needle-like crystals; consequently it is impossible to separate the paraffin wax during the sweating process. In order to understand this phenomenon it is desirable to discuss the fundamentals of the sweating process.

In the sweating process the wax concentrate is allowed to solidify on the sieves of the sweat pans, and then sweated, a procedure involving the gradual increasing of the temperature in the sweat chamber until a fractional melting, or sweating, of the higher melting point paraffin takes place. In carrying out the sweating process the first cut obtained is called sweat-oil. This oil contains all fractions from the start of the process until a cut showing a solid point of 36 deg. cent. is procured. This sweating-oil in its entirety shows an average solidification point of approximately 30 deg. cent. and consists of paraffin-wax particles in the amorphous form; therefore, it can be neither pressed nor sweated, and in consequence must be mixed with the so-called primary wax distillate, this mixture being submitted to a dewaxing process. In other words, the

sweat-oil must be recrystallized, a process very inconvenient from the standpoint of economy. The second cut obtained in the wax-sweating process is known as the return or recycling oil, which includes all cuts from 36 to 48 deg. cent., showing in its entirety an average solidification point of approximately 43 deg. centigrade. This fraction consists of the wax particles in the form of plates, and, therefore, it must be mixed with the pressed paraffin concentrate, the whole being submitted to a resweating. Of course, such a process cannot be considered as an economical method. As a third cut all fractions showing a solidification point of 48 to 52 deg. cent. are collected, these forming the commercial paraffin. Sometimes a so-called milky paraffin can be produced, due to its relatively high oil content, when the paraffin concentrate has certain content of paraffin particles in plates or in amorphous form.

Viewing the sweating process in the light of the above forces the conclusion that the paraffin-wax concentrate is composed of a mixture of various individual paraffin-wax particles present in the oil. Should the oil of this concentrate consist of the inhibitors of the first and second film, the crystallization of the paraffin-wax particles will be in proportion. When, therefore, in the first stage of the sweating process, melted paraffin concentrate is allowed to cool off in sweat pans, the needles crystalize out first, then the plates, and finally the particles in amorphous form; however, the crystallization would not occur in layers but irregularly, because all particles are intimately mixed. It results in the needles being broken by the plates, and a great quantity of plates being dissolved in the colloidal paraffin particles. With the continued lowering of temperature in the chamber, a great quantity of oil with dissolved paraffin particles of amorphous structure would leave the chamber, dissolving on their way a great number of plates.

If this concentrate then will be allowed to rise slowly and evenly, the separate components will result in an oil free from paraffin wax, all paraffin particles being crystallized in the form of needle crystals. In this instance the separation of the needle crystals and the oil takes place during the cooling of the concentrate. The oil lies freely between the needles and when the concentrate is warmed it flows down through a network of needle crystals, thus resulting in a skeleton of needle crystals free of oil. Against that the concentrate, with developed plates or broken needle crystals, reveals other properties; during the sweating process the sweating-oil dissolves many of the paraffin-wax particles. This phenomenon may be compared to a baffle that holds back the sweat-oil, thus preventing a rapid run-off.

Thus it can be seen that the concentrate, with the developed plates and amorphous particles, cannot be submitted to a sweating process. It first must be recrystallized by a repeated cooling, resulting in crystals of paraffin wax being in better condition than the original concentrate. In this instance the paraffin-wax particles are loosely packed so that the concentrate obtained is comparatively easy to submit to the sweating process. There also are certain advantages to slow cooling the mixture of oil and paraffin wax when they are at a high temperature. The high temperature makes the oil less viscous, permitting the crystals to be better formed, because the inhibitors possibly may flow down through the press cake together with the filtrate.

This process also presents many disadvantages. A high yield of filtrate rich in paraffin wax as colloidals and plates results. This so-called secondary filtrate must be mixed with the primary wax distillate in order to be partly recrystallized under high pressure in the cold presses. It can be seen that the two half products, sweating-oil and the secondary filtrate, always present difficulties in the manufacture of paraffin waxes; this procedure therefore may be considered as inconvenient, since a great deal of paraffin wax must be unnecessarily recooled and recrystallized. In consequence, the initial wax distillate will consist of 100 parts ordinary wax distillate, 40 parts filtrate obtained from the recrystallization, and ten parts sweating-oil.

This inconvenient method of processing wax distillate caused many technologists to look for a proper solvent that would remove all difficulties. Many solvents of all types have been found that would serve the purpose, such as butyl and amylalcohol, ethylen dichloride, paraldehyde, trichlorethylene, nitrobenzene, methylethyl ketone, brombenzene, and many others, but they have not solved the problem. It is true that these solvents have effected an exact dewaxing of the mother liquid, resulting in the production of a filtrate free from paraffin wax, but the paraffin-wax concentrate thus obtained crystallized into plates, presenting many difficulties in the removal of the rest of the oil and solvent by means of the sweating process. In other words, these solvents were unable to extract the second film, and thus do not permit the paraffin-wax particles to be transformed into needle crystals.

In this instance, the proper solvent must be not only miscible with the wax distillate, and possess considerable fluidity, but the presence of this solvent must so reduce the viscosity of the liquid portion and bind the second film of the process material that the solid paraffin-wax particles remaining in the form of needle crystals may be removed more readily by the sweating process. Investigations by the writer have determined that the wax distillate containing the paraffin-wax in the form of plates can be transformed into needle crystals under certain conditions. As already mentioned, the wax distillate with developed plate crystals can be pressed easily, but the concentrate obtained presents many difficulties during the sweating process. This concentrate, therefore, must be submitted to a warm recrystallization, where the separation between paraffin wax and the inhibitors occurs.

In order to remove these disadvantages the writer has devised a method that is economical and results in better yields of paraffin concentrates with developed needle crystals. This method depends upon the fact that a warmed paraffin-wax distillate containing wax particles in plates, suddenly coming in contact with a surface of cold water, results in separation of the paraffin-wax particles and the inhibitors. The separated paraffin wax crystallizes into needles; that is to say, the sudden cooling of the wax distillate causes the closed paraffin-wax particles to break off, resulting in passing over the higher molecular hydrocarbons, which form the second film, into the mother liquid. The apparatus for this process is simple and consists of a vertical cylinder equipped in its middle with a sieve. This column is filled with cold water to the level of the sieve. The outside surface of the column is also cooled with water.

This process results in the formation of two fractions: the first or upper fraction presenting a highly concentrated paraffin-wax structure with developed needle crystals. The

2051153
THE UNITED STATES OF AMERICA
TO ALL TO WHOM THESE PRESENTS SHALL COME:
Whereas FRANK RIEBER
of
Los Angeles, California
In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington this eighteenth day of August, in the year of our Lord one thousand nine hundred and thirty-six, and of the Independence of the United States of America the one hundred and sixty-first.
Attest:
Law Examiner.

RIEBER Sonograph

BRINGS SOUND - RECORDING SCIENCE TO GEOPHYSICAL EXPLORATION

FULLY PATENTED

Geophysical exploration has been revolutionized by the Rieber Sonograph, Photoelectric Analyzer and operating methods.

Recorded in the field photographically on ten separate sound tracks on a film, the multitude of reflections sent back from complex structures are accurately cataloged as to direction and instant of arrival. When sorted out and transcribed by the Photoelectric Analyzer, these reflections present a story of earth structures for study by the geologist with all of the hitherto unobtainable detail and fidelity made possible by modern sound recording methods.

The Rieber method of geophysical exploration, recording earth reflections on sound film, and the apparatus used are fully protected by the following U. S. patents. Other patents are pending.

1,776,009	1,782,445	1,867,098	1,902,184
1,780,567	1,827,371	1,902,183	2,051,153

The Rieber Sonograph works successfully through fan deposits and abnormal surface conditions. It accurately defines relatively steep or recurrently folded structures, faulting of various kinds, over-lapping or buttress sands, truncated beds, and flat-lying beds with irregular sedimentation.

A limited number of field parties is now available for work in California, the mid-Continent and Gulf Coast.

RIEBER Laboratories

1007 BROXTON AVENUE • LOS ANGELES, CALIFORNIA

HOUSTON, TEXAS

second fraction contains the paraffin-wax particles in the form of plates, and must be recrystallized in the same fractionating cooler. When the operation is completed, the water is drawn off, and then the oil containing the paraffin plates. The paraffin-wax concentrate remains in the cooler as a solid mass, and must be melted to make it possible to pump. This paraffin-wax concentrate may be submitted to a sweating process. In that event this process shows quite other results. As already mentioned, in carrying out the sweating process two cuts are obtained, their yields depending upon the character of the paraffin-wax structure. The separation between the needles and the oil takes place during cooling in the sweating chamber. The oil lies freely between the needles and when the material for sweating is warmed the oil flows down through the skeleton of the needle structure, forming paraffin wax free of oil. By thoroughly sweating the paraffin-wax concentrate formed by means of methods devised by the writer—that is, by using a proper temperature and time—a sweating-oil can be obtained with a solid point of below 0 (zero) deg. centigrade. However, this process also has some disadvantages. The second fraction obtained in the cooler contains the paraffin-wax particles in the form of plates, and therefore it must be submitted to a recrystallization in the apparatus mentioned. This fraction presents difficulties during the process, because a great quantity of inhibitors exist here in the oversaturated state. Microscopic investigations of this fraction have established that these plates are considerably less than those of the primary material. In other words, the higher concentration of the inhibitors in this fraction forms an intermediate structure between the plates and the amorphous particles. It would be necessary therefore to treat this fraction together with the third heavy fraction obtained between 0.895-0.940 sp. gravity at 15 deg. centigrade.

As already mentioned, this fraction contains two films of a tarry or resin-like substance that prevent the growth of crystals. These characteristics do not permit it to be pressed and sweated. To prevent these inconvenient characteristics the writer has used the same apparatus as that mentioned, but instead of cold water used a mixture of 95 percent benzol and 5 percent phenol. In earlier investigations[3] it was found that small quantities of phenol dissolved in a solvent was able to break up the closed paraffin-wax particles into needle crystals and inhibitors—that is, it removed the surface tension of the wax particle.

The same apparatus mentioned is filled with the mixture of benzol and phenol to the level of the sieve. The part between the sieve and the bottom is equipped with a coil through which chlor-magnesium solution flows continually from the compressor. The warmed heavy wax distillate is pumped into the top of this crystallizator. The distillate falls as a spray upon the surface of the sieve. The sudden cooling of the wax distillate causes the altering of the paraffin-wax particles, since they differ to a marked degree from the inhibitor films in their ability to conduct heat. This leads to a disappearance of the surface tension, resulting in the separation of the paraffin-wax particles and the inhibitors. Of course, phenol plays here the roll of a proper solvent that is able to make a complex compound with inhibitors and facilitates the development of needle crystals.

This process results in the following two fractions: The first (upper fraction) showing a highly concentrated paraffin-wax structure with developed needle crystals; and the second being nothing more than a solution of the oil in the solvent. After the operation is completed the solution is drawn off, and the paraffin-wax concentrate, being in a solid state, must be melted to make it pumpable. The heavy wax concentrate thus obtained now can be submitted to the sweating process with excellent results.

Considering now the run of the middle and heavy wax distillate, it will be seen that two coolers are necessary in carrying out this process. Fig. 1 is a flow diagram of this process.

This method is unique in its ability to produce a paraffin-wax concentrate in the form of a needle structure. As a result of this feature the process can produce economically, and on a commercial scale.

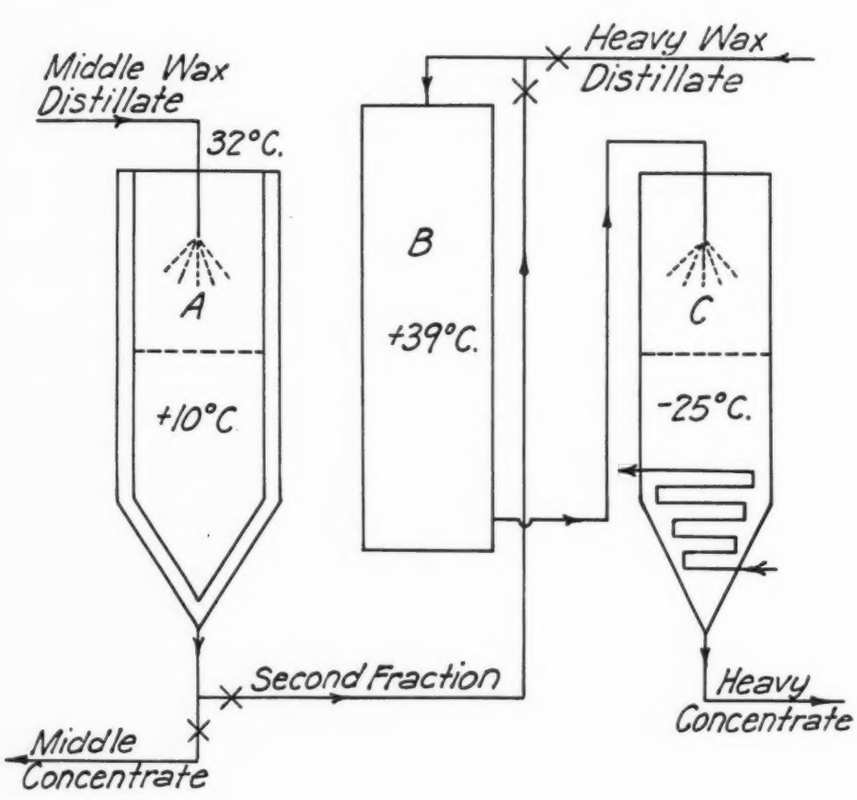


Fig. 1 (A) Cooler for the middle wax distillate. (B) Mixer for heavy wax distillate and the oil separated from the middle wax distillate. (C) Cooler for the heavy wax distillate and oil from middle wax distillate.

[1]Zeitnhr, *Angewandte Chemie*, 1888, pp. 261 and 318.
[2]*Ind. Eng. Chem.*, 1929, Vol. 29, p. 318.
[3]*Zeiteschrift fur analytische Chemie*, Vol. 91, Numbers 11 and 12.

THE ELLIOTT MODEL "A" COMBINATION ROTARY CORE DRILL is virtually made to order for operating oil companies . . designed to give the operator maximum recoveries, footage of hole, and dependable service at minimum cost. It is very simple to operate; made of the best quality materials; and when repairs are required they can be made easily and economically in any ordinary field shop. Interchangeable cutter heads make one set of coring equipment ample for all formations from the softest to the hardest. For detailed description, send for Bulletin No. 36-R.

ELLIOTT
CORE DRILLING COMPANY
4731 East 52nd Drive, Los Angeles, California, U. S. A.
Export Office: 420 Lexington Avenue, New York City

For more than a decade Elliott Core Drills have set the pace in recoveries and performance. The Model "A" shown here is the same core drill that is being used continuously by Elliott in its oil well coring service to oil companies in competition with all other types of coring equipment on a price and performance basis

The Model 'A' COMBINATION

Elliott ROTARY CORE DRILL

Elliott Model "A" with Soft Formation Cutter Head

V. J. MORONEY, Talla, Peru, S. A., chief petroleum engineer for the International Petroleum Corporation, was in attendance at the A. P. I. meeting in Chicago. He has been on leave in the United States since September and will return to Peru before the end of the year.

T. D. FOSTER, assistant drilling superintendent of the Attock Oil Company, Ltd., London, England, is studying drilling methods in the United States.

JESS O. RUSSELL, welding foreman for the Carter Oil Company, formerly at Oklahoma City, is now stationed at the Seminole, Oklahoma, machine shop.

JOHN P. HANCOCK and **WALTER FLAHIE** recently were made sub-foremen in the Keokuk, Oklahoma, district by the Carter Oil Company. **CLAYBOURNE M. WILBANKS,** sub-foreman, has been transferred from Keokuk to the Fitts Pool of Pontotoc County.

O. D. WILLIAMS has been made general superintendent of Helmerich and Payne, Inc., Tulsa, Oklahoma. Previously he was head tool pusher, and following his promotion has moved his headquarters from Oklahoma City to Tulsa.

W. H. NEWMAN now has his headquarters at Shreveport, Louisiana, and has been placed in charge of all the Magnolia Petroleum Company's drilling operations in that area except those in the Rodessa field.

R. V. KENNEDY has been made farm boss at Russell, Kansas, by the Empire Oil and Gas Company, having been transferred from Oil Hill, Kansas, where he was in the drilling department.

JOHN DOMERCQ, JR., petroleum engineer with the Standard Oil Company of California, has been transferred to The California-Texas Oil Corporation, Ltd., and expects to sail before the end of the year for Bahrein Island in the Persian Gulf.

C. I. HOLLIMAN, petroleum engineer, has been transferred from the Seminole, Oklahoma, district to the Tulsa office by The Texas Company.

H. W. SULLIVAN, chemist for the Phillips Petroleum Company at its Okmulgee, Oklahoma, refinery, has been transferred to the chemical department of the company at Bartlesville, Oklahoma .

ROY BEAN has taken over his duties as district production engineer for the Empire Oil and Gas Company in the Seminole area. Previously he was in the Chase district of western Kansas.

ROBERT E. SPEER, on December 1st, became assistant petroleum engineer with the U. S. Geological Survey, his headquarters being in Oklahoma City, Oklahoma. He has been engineer with the Phillips Petroleum Company.

F. R. CORBELL is production superintendent of the division recently formed at Talco, Texas, by the Magnolia Petroleum Company. Previously he was lease foreman at Sinton, Texas. His post at Sinton has been taken over by **J. H. SUMMERS,** who has been stationed at Mirando City, Texas.

WYLIE A. MARTIN, who for 31 years has been superintendent of production for the Sinclair Prairie Oil Company, has retired. He will continue to serve the company in an advisory capacity. No successor has been named.

RAYMOND BENJAMIN, San Francisco, California, vice-president of the Conservative Oil Company, inspected company properties in the Saxet field, Texas, recently. Other officials of the company also in the party included **EDWARD CLIFFORD,** Washington, D. C., vice-president; and **HIRAM BINGHAM.**

EARL A. SMITH has been made superintendent of the refinery of the Canadian Oil Companies, Ltd., at Petrolia, Ontario, succeeding **C. A. HALE,** deceased.

A. W. LEONARD is the new president of the Devonian Oil Company, having been chosen at a recent meeting of directors in Pittsburgh, Pennsylvania, to succeed the late J. H. Evans. He has been vice-president and general manager of the company.

GLEN HARROUN is now operating as an independent, recently starting a test in the Escobas field of Zapata County, Texas. Harroun resigned last August as superintendent of production of the Fort Worth division of the Sinclair Prairie Oil Company.

W. C. CORWIN, manager of drilling and production in Europe for the Socony-Vacuum Oil Corporation, has completed a tour of the Mid-Continent and returned to headquarters at Hamburg, Germany.

ROBERT W. ATHA has resigned as vice-president and general manager of Stewart-Atha, Inc., Mount Pleasant, Michigan, to operate independently.

CHARLES CLOWER, construction superintendent of the Huasteca Petroleum Company, Tampico, Mexico, spent his vacation in the States.

J. F. WARD, who has been affiliated with the Sun Oil Company at Mount Pleasant, Michigan, has resigned to become an independent operator.

F. W. MARTIN, drilling contractor and independent operator, has moved his headquarters from Tulsa, Oklahoma, to Shreveport, Louisiana.

W. A. MAY has been made superintendent of the Corpus Christi district by the Texas Pipe Line Company and will make his headquarters in that city. He has been assistant superintendent in the East Texas district.

A. J. MacKINNON has been made operating superintendent of the Arkansas Fuel Oil Company's new Sligo gasoline plant in Bossier Parish, Louisiana. He has been with the United Carbon Company at Swartz, Louisiana.

When a single battery of tanks can run into 4 or 5 figures it's high time to stop, look and compare before you buy . . . and make sure, that dollar for dollar, you're getting full value for your money. You OWE it to yourself.

Among "value-minded" operators who have made such comparisons Parkersburg Tanks are the outstanding favorites. Many of the features they offer are found in no other tank on the market . . . and each one makes a good tank better and saves you money. In addition our nation-wide warehouse system means that replacement parts and tank service are no farther away than your telephone. Figured in terms of time and convenience this "on the spot" service is saving operators hundreds of dollars.

Why not start today and buy your tanks on the basis of measured value? It can't cost you any more and will save you money and assure you better tanks. Begin by asking your Parkersburg representative for our complete tank catalog. It covers both Steel and Wrought Iron in every size and type.

THE PARKERSBURG RIG & REEL COMPANY
Parkersburg, West Virginia

PARKERSBURG
BOLTED TANKS

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

She: Do you think you're Santa Claus?

He: No, why?

She: Then leave my stockings alone.

* * *

A boy was walking down the street wheeling two bicycles, when he met a pal.

"Where'd you get the two bikes?" asked the pal.

"My girl and I were out for a ride," said the boy, "and we stopped under a tree to rest. After a while I kissed her. 'That's nice,' she said. Then I put my arm around her waist and asked her how that was. She said it was great. So then I kissed her on the cheek and winked at her, and she said, 'Oh, boy, you can have anything I've got.' So I took her bicycle."

—*N. Y. U. Varieties.*

* * *

The nurse entered the professor's room and said softly, "It's a boy, sir."

The professor looked up from his desk. "Well," he said, "what does he want?"

* * *

"Somebody throw an axe at ya?"

"Nope, got a haircut."

"Well, sit higher in the chair next time."

* * *

A man who had not been very good during his earthly life died and went below. As soon as he got to the nether regions, he began to give orders for changing the positions of the furnaces, and commenced bossing the imps around. One of them reported to Satan how the newcomer was acting.

"Say," said Satan to him, "you act as though you owned this place."

"Sure," said the man, "My wife gave it to me while I was on earth."

* * *

"I wish I knew what to get father for Christmas. He likes to go after small game, but I can't afford to buy him a shotgun."

"Get him a fly swatter."

* * *

"I'll be frank with you," said the young man when the embrace was over. "You're not the first girl I ever kissed."

"I'll be frank with you," she answered. "You've got a lot to learn."

Diner: I see that tips are forbidden here.

Waitress: Bless your heart, sir, so was the apples in the Garden of Eden.

—*Lufkin Line.*

* * *

Senator: What did the audience do when you said you never paid a cent for a vote and never would?

Congressman: Well, a few of them applauded, but the rest of them got up and walked out.

* * *

Ben: Will you please explain to me the difference between shillings and pence?

Hur: You can walk down the street without shillings.

* * *

Pedestrian: (to boy leading skinny mongrel pup) What kind of a dog is that my boy?

Boy: This is a Police Dog.

Pedestrian: That doesn't look like a police dog.

Boy: Nope, it's in the secret service.

—*Lufkin Line.*

* * *

Most girls are like parlor lamps—out for a good time.

* * *

Lady (watching drilling crew): Is my face dirty, Rusty, or is it my imagination?

Rusty: I don't know about your imagination, lady, but your face is clean.—*Bridgeport Bulletin.*

* * *

Proud Father: Of course, my son has studied foreign languages. Say "Hello" to the man in Algebra, son.

* * *

"Rastus," said the judge, "you are accused of disturbing the entire neighborhood on Tuesday night. What have you to say for yourself?"

"Well, suh, Judge, it was this here way," said Rastus. "Me and Lucy had a argument. She called me a lazy lofah, an, I slap her down flat. Up she hops, an' smash a skillet on mah haid, and drop me flat. Den I riz up and welt her one wid a chair! An' den she done heave a hot tea kettle at me, which sho' scald me quite considerable."

"I see," said the judge. "And then what happened?"

"Den," said Rastus slowly, "den we gits mad an' starts to fight."

A careful driver approached a railroad; he stopped, looked and listened. All he heard was the car behind him crashing into his gas tank.

* * *

A young fellow named MacDuffie got a job as motorman on a Huntington Avenue trolley car, which averages $15 to $20 a day in fares.

At the end of his first day he ran the car into the barns and turned in $102.60. The superintendent couldn't believe his eyes.

"You're a wonder, MacDuffie, how did you do it? This is a record."

"Well, I'll tell you," replied MacDuffie, "business was so quiet on Huntington that I made a dozen trips up Beacon street."

* * *

A girl met an old flame who had turned her down, and decided to high-hat him.

"Sorry," she murmured when the hostess introduced him to her. "I didn't get your name."

"I know you didn't," replied the ex-boy friend, "but you certainly tried hard enough."

* * *

An oil man had Thanksgiving dinner at a popular Tulsa cafe.

At the top of the menu was written "Turkey, 75 cents," while at the bottom he saw "NRA Turkey, 35 cents." He called the waiter for an explanation.

"The 75 cent Turkey is white meat and drumsticks," he explained. "And in the 35 cent Turkey the 'N' in NRA stands for Neck, the 'R' for ribs, and the 'A' for and-so-forth."

—*Bridgeport Bulletin.*

* * *

Visitor: How far is it to Washington?

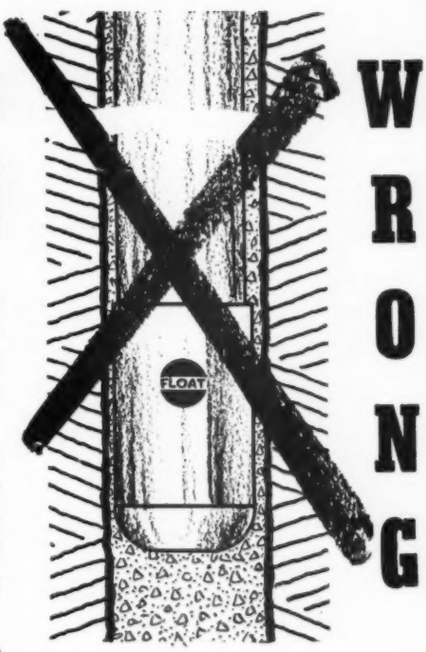
Native: Wa'al, I don't rightly know, but I'll call Eph. Eph'll know. He's traveled all over. He's got shoes.

* * *

Said the lawyer as he was making his plea for his client, who was suing the railroad for killing a cow:

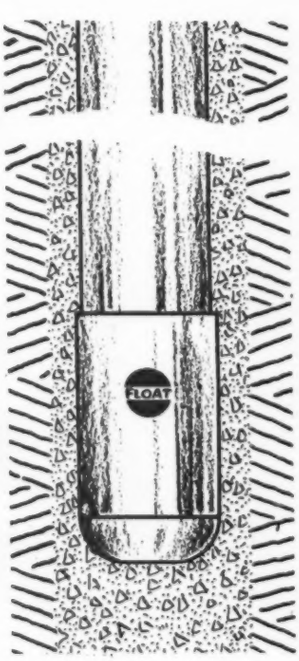
"If the train had been run as it should have been ran, or if the bell had been rung as it should have been rang, or if the whistle had been blowed as it should have blew, both of which it did neither, the cow wouldn't have been injured when she was killed."

IN CEMENTING IT'S THE Bond Between THAT COUNTS



WRONG

RIGHT



USE OF A BAKER ROTARY WALL SCRAPER INSURES AN EFFECTIVE BOND BETWEEN CEMENT AND FORMATION – THE FIRST STEP IN A SUCCESSFUL CEMENTING JOB.

Many times a thin sheath of drilling mud on the formation wall is sufficient to prevent an effective bond between the cement and the formation. Cementing failures are too costly to run such risks, especially when a Baker Rotary Wall Scraper will easily and quickly eliminate this hazard.

Before cementing, the tool is run in, and 25 to 40 feet of the hole "wall scraped" to the desired diameter. The larger area of original formation, thus exposed, insures better bonding and a thicker body of cement around the shoe and casing. It eliminates channeling by providing space entirely around the shoe joint.

OTHER SERVICES THAT MAKE THE BAKER ROTARY WALL SCRAPER AN INDISPENSABLE TOOL IN MODERN WELL COMPLETION WORK –

Increasing production – by scraping rotary mud from surface of oil sands thus enlarging productive area and bringing the well in easier and in less time • Correcting crooked hole – by cutting a wide shoulder for the bit to bring the hole back to vertical • When bottom water shut-off fails – ream out old cement and wall scrape to original or larger diameter as first step in-recementing • For tight hole – underream to permit larger size casing and liners to be run in with ease, without turning down coupling • Underreaming to clean out old wells – removes all mud and foreign matter from productive area.

Taking cores from wall of previously drilled hole – by means of a pair of blades with core-taking tubes, which convert the Baker Rotary Wall SCRAPER into a Wall SAMPLER. Actual core samples of formations penetrated are secured.

Sturdily constructed of finest alloy steel, the Baker Rotary Wall Scraper is a multi-purpose tool DESIGNED for SERVICE and PROVED by PERFORMANCE . . . Write for Details . . . or refer to the Baker section of your Composite Catalog.

BAKER OIL TOOLS, INC.

Telephone LAfayette 0153 – HUNTINGTON PARK, CALIFORNIA – 2959 E. Slauson Ave.
Telephone WAyside 2108 – HOUSTON PLANT AND OFFICE – 6023 Navigation Blvd.

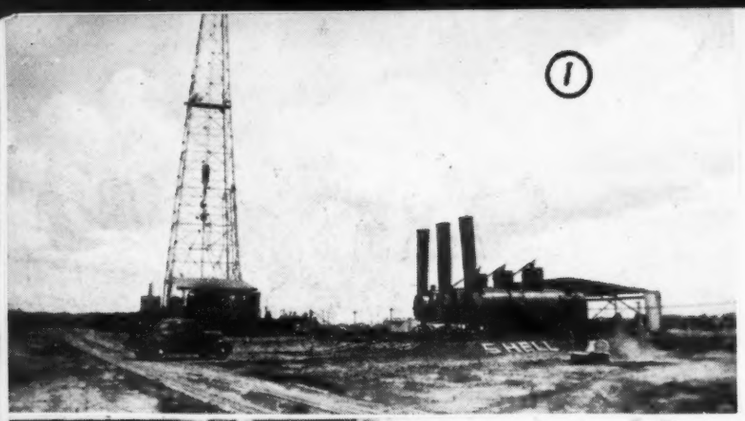
MID-CONTINENT OFFICE AND WAREHOUSE:
Telephone 2-8083 – Tulsa, Oklahoma – 312 East Fourth Street

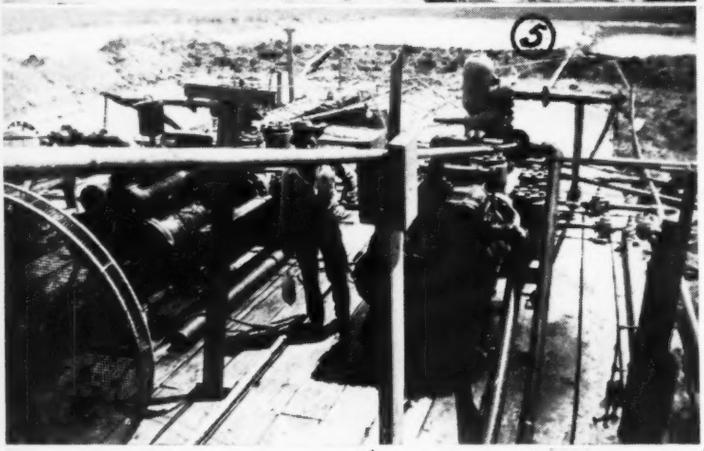
WEST TEXAS BRANCH OFFICE
Odessa, Texas – Telephone 217

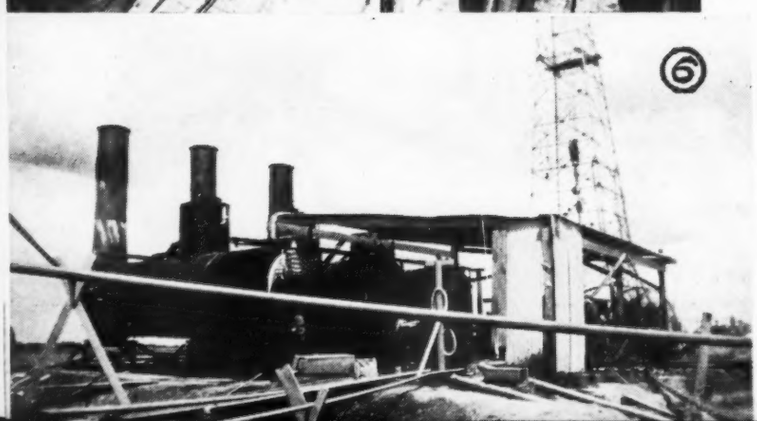
EXPORT SALES OFFICE
Rm. 1914 – 19 Rector St., New York City
Tel. Digby 4-5515

ROCKY MOUNTAIN HEADQUARTERS
Tel. 2230 – Casper, Wyoming – Box 1464

BAKER ROTARY WALL SCRAPER







Deep Test in Texas Gulf Coast

●

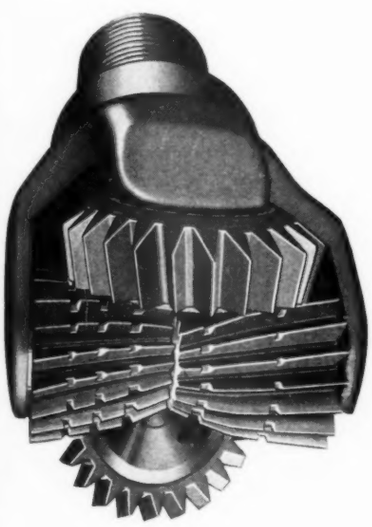
The first 10,000-ft. test well in the Texas Gulf Coast area is Shell Petroleum Corporation's No. 1 Maco Stewart, two and one-half miles southeast of Hitchcock, Galveston County. After being drilled to a total depth of 10,460 ft., the test was plugged back to 5170 feet. Tubing was set at 4940 ft., and the casing gun-perforated at a depth of 5115-20 feet. At the latest report it was making 2,000,000 cu. ft. of gas daily and a small volume of oil. Pressure on the tubing was 1300 lb., and on the casing 1900 pounds.

The accompanying photographs give a picture story of the drilling operation. Fig. 1 shows the rig, boilers, etc. Fig. 2 is a closer view of the derrick floor. Fig. 3 shows a close-up of the drawworks. Note the compactness of the unitized plant. Figs. 4 and 5 are views of the slush pump hook-up. Fig. 6 shows a close-up view of the boiler plant. Fig. 7 shows the water well, and the air compressor installation.

MACHINERY and EQUIPMENT

The H. C. Smith Rock Bit

THE new H. C. Smith rock bit incorporates many new features in rock bit construction, according to the



manufacturers. The two gauge cutters have conventional roller bearings plus two thrust ball bearings, eliminating possibility of any play in the cutters. This play in the cutters would result in the formation forcing the cutters inward and causing a loss of gauge in hole.

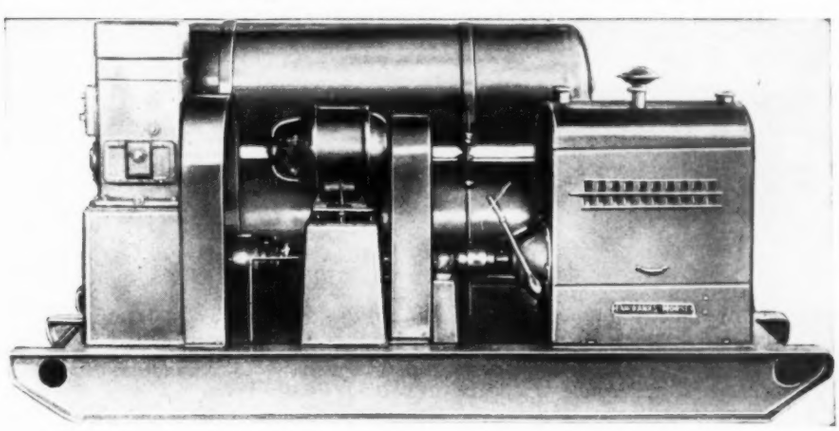
A deep and proper shaped tooth insures a maximum amount of diamond substitute metal plus the the ultimate in the hardness of the metal itself.

The cross roller assembly is made of a special alloy steel, pin heat-treated and greatly increased in size over the conventional cross pin, eliminating any danger of breakage, it is stated by the makers.

Accompanying is a cut of the model BR (barrel roller type), one of the successful designs used in the H. C. Smith rental service for California. Shape of cutters insures a maximum clearance for circulation wash, plus a tooth proportion equal to the area of the hole being cut.

A full line of rock bits is carried for soft, medium, and hard formations. The different formations encountered in the various fields tend to decrease the efficiency of any one type of cutter tooth. With this in mind Smith engineers have evolved several types of cutter tooth edges, designed particularly to allow easy penetration and fast cutting by the bit. Inherent characteristics of this bit are its smoothness in operation and ability to dig straight holes. This company has completed the installation of new and heavy-duty oil tool equipment to facilitate the production of their new rock bits.

New Auxiliary Oil Field Set Is Built of F-M Units



A NEW auxiliary generator and air compressor set for rotary drilling rig service in oil fields has just been built with Fairbanks-Morse units by the Emsco Derrick & Equipment Company of Los Angeles, California.

Power is supplied by an 11½-hp. F-M-3 multi-cylinder Industrial Power Unit. This engine is equipped with a combination butane and gasoline carburetor, with fuel tank for gasoline under the hood and with necessary fittings for connecting the butane regulator to a fuel supply line. The power unit has safety devices for both oil pressure and water temperature, an oil bath type air cleaner, and an oil filter. Power take-off is through a clutch.

The F-M 3-kw., 125-volt, d-c., 1500-r.p.m., Type DGZM generator is driven from a counter-shaft through a V-belt drive.

The F-M 2-stage Type H air compressor, driven from the countershaft through a clutch by a multiple V-belt, operates at 800 r.p.m. Two 20-in. by 60-in., 250-lb. pressure, A.S.M.E. Class 2 air tanks are mounted on one side in a suitable saddle. Instrument panel, with voltmeter, ammeter, and rheostat, is not illustrated.

The steel frame is constructed of three 12-in. I beams with 3-in. cross pipes at each end, and ¼-in. steel plates. The entire frame is welded, rather than bolted or riveted.

G-E Motors of New Design

A NEW design of riveted-frame squirrel-cage polyphase induction motors, in frame sizes of from one to 15 hp. at 1800 r.p.m., has been placed on the market by the General Electric Company, Schenectady, New York. The new motors, available in a variety of electrical and mechanical modifications, incorporate improvements in stator-coil insulation, frame construction, and other design features, the manufacturers state.

Coördination of design permits the different modifications of motors in the line to be used interchangeably for many types of power supplies and for various applications requiring open, sleeve- or ball-bearing, enclosed, enclosed fan-cooled, splashproof, vertical motors, etc. As a result of this adaptability, many special requirements may be met with the standard available line.

A new insulation system "built from the inside out" is employed for the stator-coil windings, which are of the random-wound type, with joints at the connections fused instead of soldered. Recently-developed insulating materials and processes are utilized, eliminating the need for taping the end windings and producing an insulation assembly with high resistance to moisture and other common deleterious influences, such as mild acids, alkalis, oil, and abrasion.

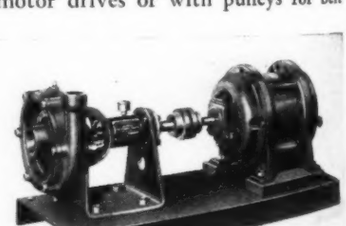
A new riveted-frame construction and new end frames made of malleable iron, with integrally-cast feet, contribute to the strength and rigidity of the motors, providing increased resistance to vibrating and shock loads. Cast-iron end shields of ample strength maintain accurate bearing alignment and uniform air gap.

Small Centrifugal Pumps Announced by Worthington

A SMALL, high-quality, low-cost centrifugal pump is announced by Worthington Pump and Machinery Corporation, Harrison, New Jersey.

The utilization of a pressed-steel frame, combined with quantity production, make possible a low-cost unit, it is stated. Simplicity of design results in fewer wearing parts and low maintenance costs, it is pointed out.

The pumps are supplied with direct motor drives or with pulleys for belt drive. The motor sizes range from one-third to three hp., delivering from 10 to 130 gal. per minute with heads from 10 to 100 feet.



The shaft is supported by two ball bearings enclosed in a dirt-proof and moisture-proof housing. The suction head is easily removable for inspection of the pump's interior. A choice of standard, all-iron, and all-bronze fittings is offered.

WITH **WAUKESHA** POWER

This Cardwell rig, built by the All-Steel Products Manufacturing Company of Wichita, Kansas, is doing a real job of oil well servicing—because it is powered by a 100-112 hp., six cylinder Model GAKU Waukesha Oil Well Servicing Engine.

Built to meet the demand for modern power units that will stand up under the severe conditions encountered in oil field service, Waukesha Oil Well Servicing Engines range in size from 40 hp. to 112 hp., and burn either gas or gasoline.

Their design embodies many advanced features . . . it will pay you to get complete details.

WRITE TODAY FOR BULLETIN 1019

WAUKESHA MOTOR COMPANY
WAUKESHA WISCONSIN

WAUKESHA ENGINES

Brake Band Exchange Service Inaugurated

A NEW type of service to the field was inaugurated recently by W-K-M Company, Houston, Texas, manufacturer, in its novel brake band exchange service. By means of this service exact duplicates of the rig owner's original bands are exchanged

on the derrick floor, thereby eliminating a shutdown of several hours. The bands with worn lining are taken to W-K-M's factory, where they are reworked and relined. Old bands are cleaned and painted with rust-resisting paint before relining. Clevices are rebushed, if necessary, and all kinks and bends are removed as a part of the service job.

The exchange service provides on the field job solid interwoven lining made to the manufacturer's specifications. Friction material, said to result in minimum scoring or wearing, is employed.

As an additional feature of the service, W-K-M Company will supply, cut to desired lengths, the same brake lining to operators who desire to make their own installations.

The manufacturer will gladly supply literature explaining this new service in detail upon request.

Watson-Spicer Shaft

THE H.S.WATSON COMPANY, San Francisco, announces the new Watson-Spicer Needle-Bearing Flexible Shaft. It is claimed that this coupling allows angular misalignments up to 20 deg. and can transmit up to 250 horsepower. The Watson-Spicer Shaft can be supplied in lengths from a few inches to several feet, depending on the installation. The longer lengths provide an ideal arrangement for driving hot oil pumps where intervening fire-walls prevent close-coupling, etc., the makers state.

According to the manufacturer, endwise movement up to 1½ in. can be compensated. Construction is entirely of metal and the use of needle-bearings decreases friction and noise. Literature can be obtained from H. S. Watson Company, 525 Fourth Street, San Francisco, California.

ACCEPTED

TWO NEW HYDRO-SEAL PLUG VALVES!

Model E.L. 250 lbs. W. P.

Model S.M. 500 lbs. W. P.

IDEAL FOR REFINERY USE

These two newly-designed, low-pressure models have met with world-wide acceptance. Order a few and be convinced of their superior service and longer wear.

DON'T JUDGE HYDRO-SEAL BY OTHER PLUG VALVES Hydro-Seal Plug Valves are made in working pressures from 250 lbs. to 3,000 lbs. Models to meet your every requirement. Sizes range from ½ inch to 20 inches. Designed with union ends, flange ends and screw ends.

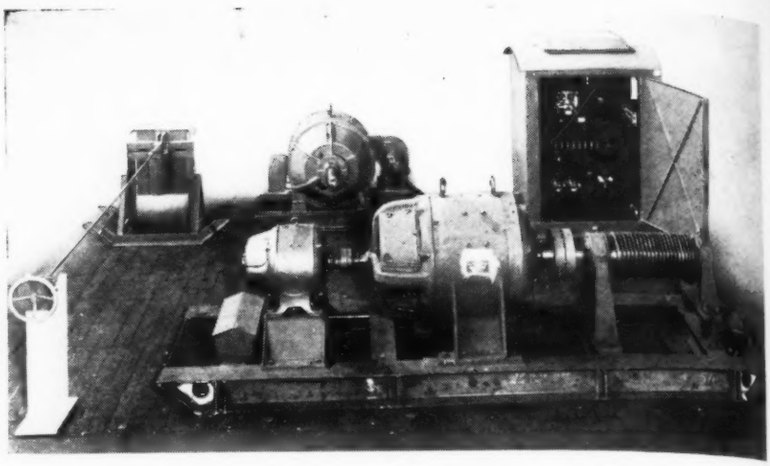
All models of Hydro-Seal Valves have recently been improved either in design, method of manufacture or materials. These recent improvements make them the valve value of the day. They turn easier—hold more pressure and last longer.

Sold by Supply Stores Everywhere

MacCLATCHIE
MANUFACTURING COMPANY
COMPTON, CALIFORNIA HOUSTON, TEXAS
Export: GEO. R. WOODS, 17 Battery Place, New York

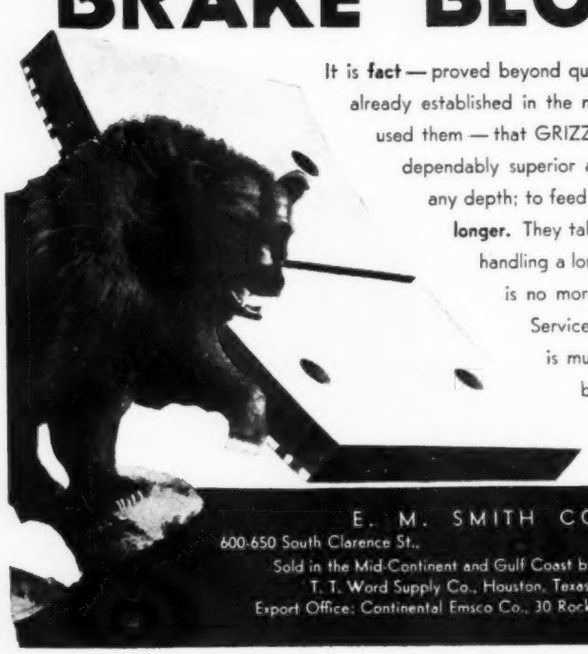
Mechanical-Electrical Drilling Rig for the Oil Field

ALLIS-CHALMERS Manufacturing Company, Milwaukee, Wisconsin, manufacturer of electrical and transmission machinery for drilling rigs used in oil fields, has announced a new combination mechanical-electrical drilling rig, known as their EM rig. Although all their drilling rigs utilize various makes of Diesel engines the methods differ. In their all-mechanical driven rig both the drawworks and the slush pumps are driven directly from Diesel engines through texrope V-belt drives. In their all-electric rig the two or more Diesel engines are connected through texrope drives to generators that supply d-c. to a drawworks motor and to slush pump motors.



In the newly-offered combination EM oil well drilling rig the drawworks motor is again driven by power produced by a Diesel engine texrope-driven generator, but the slush pumps are mechanically driven directly by the same Diesel engines through texrope drives. This method, with the pumps mechanically driven, eliminates the need for a pump motor as well as one of the two generators usually employed in the all-electric type rig. Much interest is being shown in the new mechanical-electrical type rig, a number of which are now in successful operation.

HOLDS THE LOAD
SAFELY
..at any depth
GRIZZLY
FULL-MOULDED
BRAKE BLOCKS

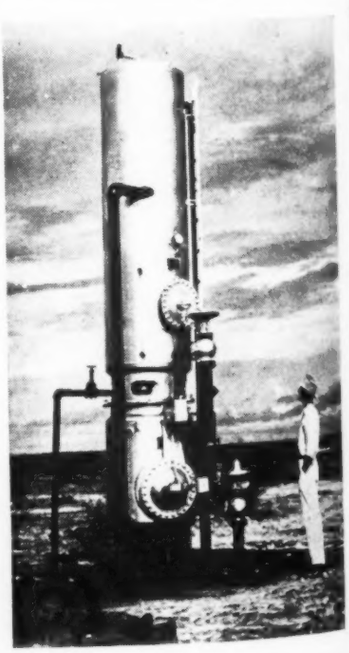


It is **fact** — proved beyond question or argument — and already established in the minds of drillers who have used them — that GRIZZLY BRAKE BLOCKS have dependably superior ability to hold the load at any depth; to feed off **smoother**, and to wear **longer.** They take a lot of the grief out of handling a long, heavy string. First cost is no more than other good linings. Service cost, due to longer wear, is much less. Distributors listed below will give you prices and any desired information.

E. M. SMITH COMPANY
600-650 South Clarence St., Los Angeles, Calif., U. S. A.
Sold in the Mid-Continent and Gulf Coast by: Continental Supply Co., T. T. Word Supply Co., Houston, Texas - In All Their Stores:
Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City.

The B S & B Meter Separator

THE accompanying illustrations are of a Black, Sivalls and Bryson, Oklahoma City, Oklahoma, meter separator in Ward County, West Texas, that checked tank gauges during two



months of testing with an average error of .52 percent (fifty-two hundredths of one percent). Best test .35 percent; worst test, .89 percent.

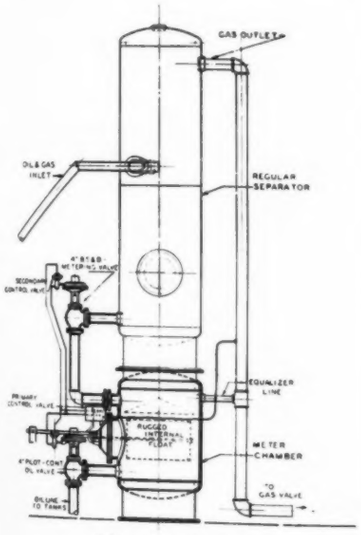
The upper vessel is a standard BS&B separator with float removed. It is lifted on top of the meter chamber, which is nearly filled with a huge, sensitive ball-bearinged float to actuate snap-acting pilot inlet and outlet valves that let in, count, sample, and let out exactly one pipe line barrel at a time.

A BS&B meter separator will gauge the production of each individual well, then deliver it by full separator pressure to the lease central gathering plant, saving evaporation losses, the manufacturers state.

It is adaptable to the new crude oil stabilization plants where oil from several leases must be metered separately, then delivered at highest pressure to the stabilizers without tank exposure, it is stated.

It provides an accurate, continuous check upon the oil, B.S., and water from each well.

The operation of the BS&B meter chamber is simple. It is, in fact, merely an accurate gauging tank in which a large float is suspended from a ball-bearinged, frictionless trunnion shaft.



3' DIA - 125 LB WP METERING CHAMBER FOR OIL & GAS SEPARATORS

A mere ounce of touch by the float arm when the chamber is full trips the sensitive baby primary pilot valve, which causes the meter inlet valve to slam shut, the meter discharge valve to jerk open, and a barrel of oil to register on the sealed counter. A minute proportion of each dump of the meter is automatically drawn off for the daily average sample of oil, B.S., and water.

The sensitive baby primary pilot valve is truly the heart of the BS&B meter. It is adjustable by hundredths of a barrel. It can be set, for example, to trip at 1.09 bbl. if the particular oil shrinks .09 of a bbl. by gas loss from separator pressure to stock tanks. Thus it will deliver exactly one bbl. of pipe line oil, corrected for gas losses.

The BS&B meter has no close-moving parts to wear out. It will not plug up with sand, nor will sand cut it to pieces so it will soon become inaccurate, the makers claim. Its float has a buoyant force of 92 lb., yet only one ounce is required to operate the baby primary valve.

The main meter inlet and outlet valves are the BS&B single plug and seat, pilot-operated type.

The BS&B meter separator is made in two styles:

(1) The BS&B separate meter chamber, which is illustrated, and which can be set under any separator already in the field.

(2) The BS&B meter separator that incorporates into one unit the manufacturer's high-duty separator, with the meter chamber built in beneath it.

The only difference between these two units is that one is in two pieces and the other is in one piece.

Maximum Results From Your Oil Loans

One dollar looks pretty much like any other dollar, but every NATIONAL BANK OF TULSA loan has a different look, because each one is made to fit individual requirements. *And that's the nub of the whole matter.*

When you borrow money at this bank, you get personal, qualified co-operation in addition to the cash you receive. You get technical, legal, and practical assistance that gives a plus value to the worth of your money. An *Oil Bank of America Loan* gives you a financial standing in the oil industry.

Oil men know that these "extras" help them to get the maximum results from the money they borrow at this bank.

Good oil loans make excellent investments for our depositors' funds. Our officers want to make all such loans they can.

NATIONAL BANK OF TULSA

NATIONAL BANK OF TULSA NBT

Member Federal Deposit Insurance Corporation

Taper Cutting Die Head

A SPECIAL heavy-duty taper-cutting die head for handling threads of large diameters, steep tapers, and extra lengths, has been added to the line of die heads manufactured by the Landis Machine Company of Waynesboro, Pennsylvania. Known as a Special 6-in. Landmatic, it augments the line of Landmatic die heads with taper attachment previously manufactured in sizes up to 4 inch. The head is of the six-chaser type and was designed for threading parts used in the oil industry, such as tool joints, drill stems, etc.

This head is a stationary type adapted for use on a heavy-duty turret lathe. An adjustable bar, mounted on some stationary part of the machine, retards the cam carrier as the head advances onto the work. The adjustable bar is set to have contact with the cam carrier just as the part to be threaded enters the die. The sliding movement of the cam along the cam shoe allows the chasers to recede at a uniform rate and produces a tapered thread corresponding to the taper of the cam. The head opens automatically when the cam trips off the end of the cam shoe.

Before the head is closed, the carriage must be returned a sufficient distance to clear the stop bar. The adjustment for thread length limits the forward travel of the cam carrier and insures threads of uniform diameter and length, the makers state.

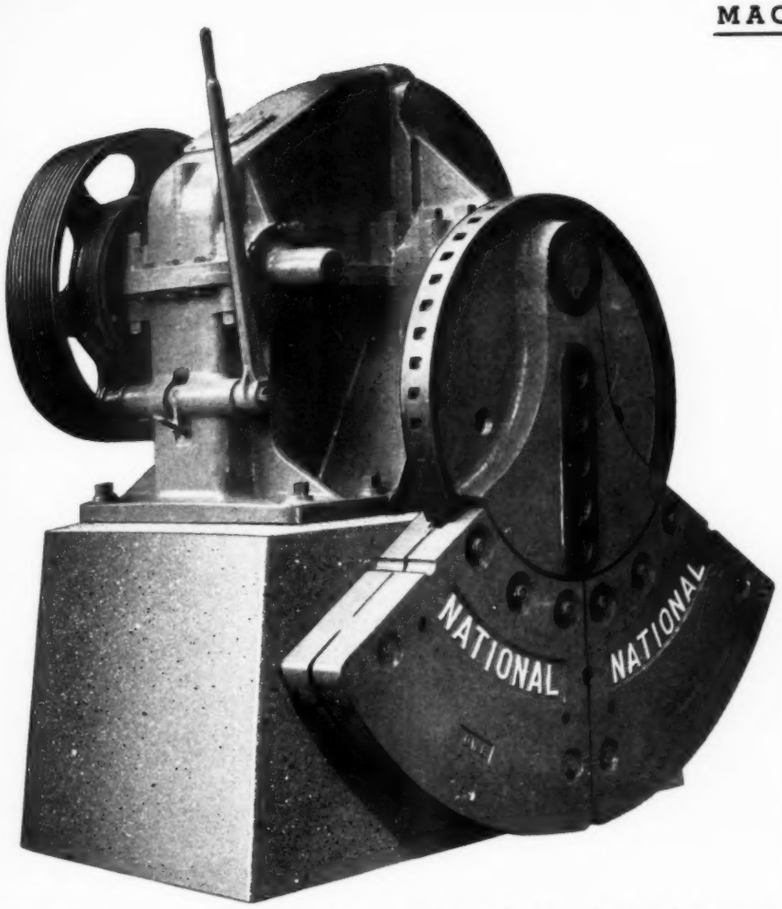
Reduction Gears for the Complete Range of Pumping Requirements

NATIONAL Supply Company Type H reduction gears are made in seven sizes to cover the complete requirements of oil well pumping. Both single and double reduction types are available in the capacities where both slow- and high-speed prime movers are commonly used. A.P.I. tentative hp. ratings range from 10 to 70 at 20 s.p.m. A feature of these gears is their all around utility. They can be used as a central power, or to pump a single well with additional wells, if desired, through back crank arrangements. Hoist drive sprockets can be provided, if required.

National reduction gears are completely symmetrical in design and arrangement. Bearings, gears, and shafts are alike on each side of the case. Heat-treated shafts of generous size are mounted in heavy-ribbed housings. Crankshaft bearings are of the renewable split bronze pattern with thrust flanges to prevent wear on gear housings. They are made in two perfect bearing halves without gap at the split and are bored after assembly in case to insure alignment. Special attention has been given to back crank loads by providing an unusually wide main bearing split vertically in direction with the load. The pinion and intermediate shafts are equipped with oversize, self-aligning roller bearings that permit the gears to float in perfect adjustment with the slow-speed gear, the manufacturers state.

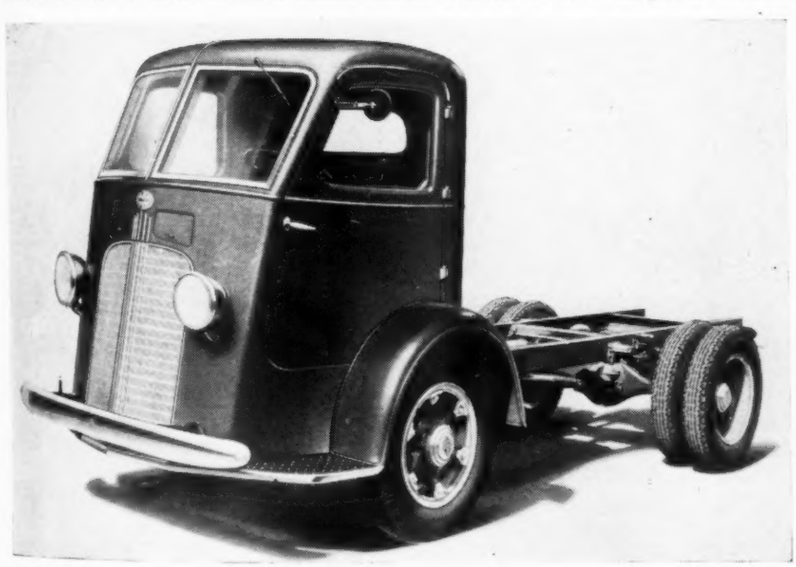
Sykes herringbone gears generated by National are used on all sizes. On double-reduction gears, the high-speed gears and pinions are of the spaced herringbone type. In this design, the two halves are cut in pairs as if they were one continuous herringbone gear. Bearing loads are equalized by dividing the high-speed train, thus adding greatly to the life and continued efficiency of the entire unit. All gears are generated on Ferrel generators and are lapped and run in under load at the factory. The oiling system is simple and automatic in operation.

Counterweighting is made effective by National disc cranks and adjustable counterweights. The weights are made in two halves securely clamped over the rim of the cranks. To change position,



the bolts are loosened, allowing the weights to slide freely on the rims. This makes it possible to turn the cranks to the desired position for reclamping the weights. The powerful and sensitive service brake is used to hold the cranks in position while the bolts are being tightened. Adjusting counterweights by power is an exclusive National feature, it is stated.

International Harvester Announces Seat-Over-Engine Truck



INTERNATIONAL Harvester has announced a new cab-over-engine truck of 1½-ton rated capacity known as the Model C-300. In this latest unit, designed to meet modern requirements for greater load space with less overall length, better load distribution, and easier maneuverability, the driver is seated directly over the engine, not alongside the rear of it. All heat and fumes, therefore, pass out beneath the seat at the rear of the cab. This eliminates the ventilation problem usually found in trucks of

CLEAN OUT

with the improved

MILLER SAND PUMP

quickly removes the loose sand

The MILLER Sand Pump equipped with the Chisel Bottom (illustrated below) will break up the sediment and cavings by dropping it a few times in the well. The enormous suction thus created by the plunger travelling upward in the tube, will pick up a load of sand and mud that a common bailer cannot possibly pick up, *speeding up production and getting the well quickly back on the pump.*

SAND BOTTOM

Used when tools are run and when well is shot to quickly remove loose material.

STAR BOTTOM

Used for cutting the sand loose.

BAILER BOTTOM

With the Bailer Bottom installed the Miller is changed to a Bailer, giving you a combination of either a Bailer or Sand Pump in one tool.

MILLER SAND PUMPS ARE SOLD BY SUPPLY COMPANIES EVERYWHERE

Write for Descriptive Folder and Price List

CHISEL BOTTOM
(In Pump)

Will often save the expense of running tools, as its chisel shape breaks up tightly-packed sands.

PATENTED
No. 1370340
No. 1523604
No. 1787390
No. 1862628
No. 1866828
No. 2055667

MILLER SAND PUMP CO.

Gen'l Offices and Shop, Box 4516
OKLAHOMA CITY, OKLA.
Branch Shops and Offices:
Sapulpa, Okla., and Kilgore, Tex.

this type because the heat has not been permitted to enter the driving compartment.

The International Model C-300 is available in 99-in. and 117-in. wheelbase lengths and is adapted to body lengths up to and including a maximum of 15 feet. Its design, while permitting bodies of this length, also permits a reduction in overall length of approximately three feet compared with conventional units suited to the same body sizes.

This design makes it possible to procure the ideal weight distribution of 1/3-2/3 between rear and front axles, which results in more uniform tire wear on all six tires, and in greater braking efficiency, especially on the front wheels due to the increased weight on the front tires, the manufacturers state. This results in more uniform wear and consequent longer brake lining and drum life.

Another feature of the Model C-300 is its maneuverability. Shorter wheelbases and the wide-tread front axle make possible this International's unusually short turning radius. Shorter turning radius naturally contributes to easy parking, and makes it possible to handle the truck with greater ease in tight places.

THE ANSWER to a natural desire for essential first-hand information in your line of work—is a subscription to

The

PETROLEUM ENGINEER

Order a personal copy now to be mailed to your home. Use the coupon below.

Rates: One year, $2.00; two years, $3.00.

Send $3.00 for two years and save $1.00.

THE PETROLEUM ENGINEER,
P. O. Box 1589, Dallas, Texas.

Date_____

Enclosed is $_____ for a _____ year (new) (renewal) subscription.

*Name*_____

*Title or Occupation*_____

*Company*_____

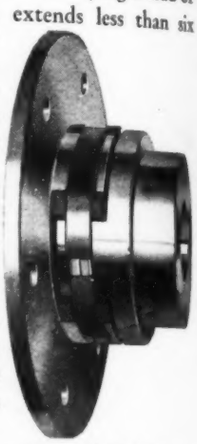
*Street or P. O. Box*_____

*City*_____ *State*_____

L-R Flexible Couplings

LOVEJOY TOOL WORKS, 4983 West Lake Street, Chicago, Illinois, announces an L-R coupling of new design, the Type WF, which is made with one of the bodies in the form of a flange that bolts onto the flywheel or a clutch or brake drum of a Diesel, gas, or steam engine.

The flange-body design reduces the overall length of this coupling by one-third. A recently-installed WFR-800 coupling, capable of carrying a load of 324,000 in-lb., extends less than six in. beyond the rim of the flywheel. This saving of space allows many more inches for frame and other parts, and according to the makers, adds considerably to the efficiency and life of both drive and driven unit.



The L-R Type WF Flexible Coupling will be made in sizes from 3-in. to 14-in. bores suitable for 2500 hp. at 100 revolutions per minute.

As on the well-known L-R Type W, free floating load cushions are held in place by a quickly removable outside retaining spring. This permits larger hubs and greater load carrying surfaces with consequently increased carrying capacity. The load cushions are always in plain sight and can be removed and replaced in a few minutes without tearing down the coupling. This principle has been thoroughly tested in seven years of service.

Three types of resilient cushioning material are available for each of these couplings:

1. Metalflex—a high-grade, long-wearing brake lining material, used for heavy shock loads.

2. Leather load cushions—of best oak tanned belting leather, for use on sustained loads and greater misalignment.

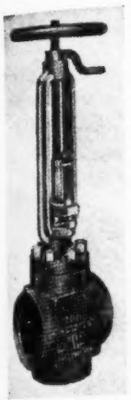
3. Multiflex cushions—a rubber duck fabric, vulcanized under high pressure, for use on fluctuating loads and where high resilience is required.

By application of suitable materials and design, capacities may be increased without change in overall dimensions.

For further information, details, and literature on the new coupling, address the manufacturer.

Precision Flow Control On Prorated Wells

TO meet an ever-growing demand for an accurate and economical flow control on prorated wells and for back-pressure control on sand producing wells, the Kerotest Manufacturing Company claims to have developed a 100 percent complete line of adjustable control chokes, especially designed to afford an economical and efficient method of flow control on any Christmas tree hookup regardless of pressure or size.



Kerotest Cross Type Full Flow Chokes

Tested to 6000 lb. per sq. in. for working pressures up to 3000 lb. per sq. in., these chokes are made in two general types: Tee type and Cross type—the Bolted Bonnet and the Screwed Bonnet design. The Bolted Bonnet types are designed with female inlet and outlet openings while the Screwed Bonnet types include the female openings, male and female openings, and all male openings.

Cross type chokes include one design with a restricted orifice bushing for sensitive control of production under high pressure sand conditions and one of the full-flow type to permit flow up to the maximum of the well tubing. These chokes are attached directly on top of the well and provided with a full opening straight down the tubing string for the passage of swab or other equipment without removing choke from the well.

The full-flow choke has an opening through the seat equal to the maximum inside diameter of external upset tubing, permitting flow of maximum production when desired. It is adjustable and can be throttled to any smaller sized areaway desired with the diameter of such areaway clearly shown on indicator.

Bodies and bonnets of all screwed types are made of alloy steel, heat-treated drop forgings. Bolted Bonnet types in sizes 3 in. and smaller also are made of heavy alloy-steel drop forgings, while the 4 in. and 6 in. Bolted types are cast of heat-treated alloy steel.

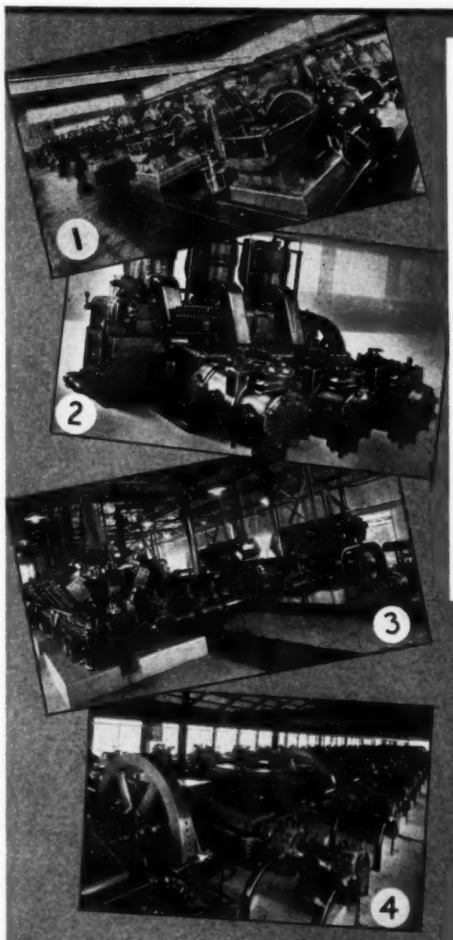
The alloy-steel yokes have a bronze bushing securely threaded in position, precluding possibility of stem sticking or galling. The flow indicator consists of a snugly fitting brass tube pinned to stem and carries the graduated markings or scale of orifice opening in fractions.

Orifice bushing and adjusting needle are made of alloy steel hardened and ground to precision; needle is attached to stem by tightly fitting threads and locked into position with very heavy locking washer and locking pin.

The stem operates through a hardened bronze stem nut, securely pinned into position. Stem position may be definitely maintained by means of locking wrench, which is a part of every control choke.

Kerotest adjustable control chokes are manufactured by the Kerotest Manufacturing Company of Pittsburgh, Pennsylvania, pursuant to license under the Petroleum Engineering Research Patents granting full authority for their manufacture and sale in any oil field throughout the world. A new descriptive bulletin may be obtained from the above manufacturer upon request.

Seal your reciprocating piston rods
the way so many engine and compressor builders do . . . with
COOK'S METALLIC PACKINGS

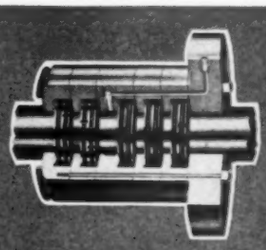


1-COOPER-BESSEMER CORP.
2-CLARK BROTHERS COMPANY
3-INGERSOLL-RAND COMPANY
4-WORTHINGTON P&M CORP.

Any engine or compressor is a more efficient unit if its rods are fitted with COOK'S METALLIC PACKING. The leading engine builders recognize this fact. Noteworthy applications are represented by the equipment, shown in the accompanying illustrations, that comes factory-equipped with COOK'S PACKINGS.

There is an approved type for all pressures fitted with packing rings made of COOK'S GRAPHITIC IRON, Cookmet, Babbitt or Micarta, as the requirements of service suggest.

For existing equipment, communicate with us direct or our nearest branch office.



C. LEE COOK
MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.
NEW YORK • LOS ANGELES • CHICAGO
NEW ORLEANS • CLEVELAND • TULSA
BALTIMORE • SAN FRANCISCO

No Interruptions of Service with Repair Sleeves

TAKING its cue from last winter's experience with sub-zero weather, epidemics of pipe breaks, and rush orders from maintenance departments for split repair sleeves, the S. R. Dresser Manufacturing Company of Bradford, Pennsylvania, has announced special arrangements to meet an even heavier demand in the next few months.

These sleeves, which permit full or partial service to be maintained while the repair is being made, are especially designed to effect a complete and permanent repair of any split, break or hole in any type pipe line, in the shortest possible time. According to the manufacturers, it takes only a few minutes to enclose the broken pipe with a Dresser Split Sleeve—using only one tool, a wrench. It is not necessary to get a "dry" hole first; there are no joints to pour and calk; no waiting time; no idle crews.

The sleeves may be installed under water, if necessary. Often the break can be fixed without shutting down service on the line at all. The repair thus made is permanent, say Dresser engineers. It never needs to be removed or replaced, and its flexibility helps greatly to prevent future breaks at or near the same point.

The accompanying photographs show how a typical break in a 4-in. water pipe was repaired with a Dresser Style 57 Split Sleeve. Two or more sleeves also can be joined together in a multiple installation to cover breaks that are longer than eight inches. Dresser Split Sleeves are made in a number of different styles to fit various needs. Style 52A is for repairs on steel pipe or joints where working pressures run up to 500 lb. per sq. inch. Style 73 is for the same type of repair where working pressures of not more than 250 lb. permit use of a lighter sleeve. Style 57 is for breaks in the straight run of cast-iron pipe, and Style 26 is used for repairing broken or split bells, or breaks in cast-iron pipe close to the bell. Style 54A is recommended for enclosing and repairing bolted joints of various types on steel pipe.

Here's how one 4-inch water main looked when the repair crew got down to it.

And here is the same pipe a few minutes later—the break now permanently repaired with a Dresser Style 57 Split Sleeve

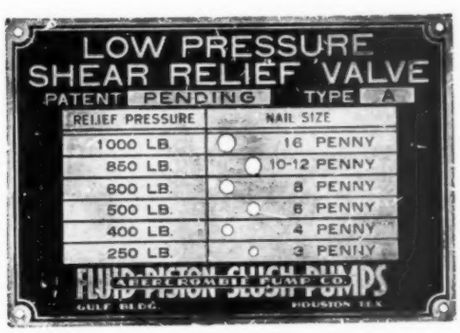
Increasing use of Dresser Split Sleeves during last winter's sub-zero weather has led to an unusually heavy pre-season demand this year, the makers state. Special efforts have been made at the Dresser plant to build up extra inventories of all styles of repair sleeves, and arrangements have been completed to give special attention to emergency orders, it is said.

Gustin-Bacon Officials on Annual Tour

Officials of the Gustin-Bacon Manufacturing Company, Kansas City, Missouri, accompanied by representatives of some of the firms whose accounts they handle, recently made their annual tour of the Mid-Continent. Those making the trip are shown in the photograph, except A. L. Gustin, Jr., vice-president of the Gustin-Bacon Manufacturing Company, who was not present when the photograph was taken in Tulsa. Reading from left to right are: Charlie Wheatley, Gustin-Bacon Manufacturing Company, Kansas City; W. C. Winings, manager sales, mechanical goods division, Goodyear Tire and Rubber Company, Akron, Ohio; R. J. Potts, R. J. Potts and Company, Kansas City; J. F. Stephens, general manager, Gustin-Bacon; D. K. Chadbourne, vice-president, Worthington Pump and Machinery Corporation, Harrison, New Jersey; G. A. Waddle, legal department, Goodyear Tire and Rubber Company; Frank L. Myers, manager filter division, Owen-Illinois Glass Company, Toledo, Ohio; "Puny" Blevins, Gustin-Bacon, Tulsa; T. B. Walker, Goodyear Tire and Rubber Company, Dallas; Virgil F. Halliburton, development engineer, Gustin-Bacon; R. S. Wilson, vice-president in charge of sales, Goodyear Tire and Rubber Company; A. L. Gustin, Sr., president, Gustin-Bacon; D. E. Tessendorf, Worthington Pump and Machinery Corporation, Fort Worth; and M. Shields, assistant general manager of Gustin-Bacon.

SO SIMPLE TO SET!

This is the low pressure SHEAR-RELIEF Valve, for gathering pumps, or similar service.



No One Can Misunderstand Setting Directions Like These . .

● Full instructions for setting the SHEAR-RELIEF Valve are given right on the name plate . . . the pressure at which each size nail shears, and the nail gauge to avoid error in the nail size required. The SHEAR-RELIEF Valve at the left shows the position of the nail . . . anybody can set it.

FLUID-PISTON SLUSH PUMPS
ABERCROMBIE PUMP CO.
GULF BLDG. HOUSTON TEX.

THE DITCHER for BIG PIPELINES

Buckeye Model 48—"The Pipeliner"—built to cut the largest pipe line ditches.

The most important pipe lines the world over are laid in trenches dug by the Buckeye Pipeliner.

Your cost figures are based on known performance when "The Pipeliner" digs the ditch.

THE BUCKEYE TRACTION DITCHER CO. FINDLAY OHIO

BID THE Buckeye WAY ask for our operation data before you bid

Buckeye

WHERE DEPENDABILITY CANNOT BE OVERLOOKED

Nothing conspicuous; nothing to catch your eye and make you stop; but there on the job serving you day and night — sure, reliable, accurate — are the dutiful Chaplin-Fulton Regulators. They show best where dependability is not to be overlooked.

Because you can be sure of Chaplin-Fulton constancy: that's the reason Chaplin-Fulton Regulators have led in all regulation service for over fifty years.

THE CHAPLIN-FULTON MFG. CO.
28-40 Penn Ave. Pittsburgh, Pa.

CF

Chaplin-Fulton 2" Low Pressure Cut-off Regulators on fuel line to compressors at Fairfax, Okla.

Solving Power Problems

With increasing loads racing toward the capacity of equipment, many power companies find it necessary to solve quickly new generation and distribution problems. Five companies wishing to determine accurately the added power needed and the load limits and stability of their systems have recently engaged the Westinghouse a-c. calculating board to analyze their problems.

During the past year 18 major system studies involving plants up to 500,000 kva. capacity have been completed on this board. These systems included eight utilities, six government projects, two industrial plants, and two foreign power systems. Four utilities and one industrial system are definitely scheduled for the immediate future and efforts are being made to accommodate many others.

This a-c. calculating board with its 300 circuits can readily duplicate by miniature replica any power system in this country. With its aid, system stability, power factor correction, load-voltage regulation studies, and the best location for new generating, transformer, and line equipment are readily determined. Through the accurate and comprehensive analysis made possible by these facilities users are able to curtail investment in standby equipment, and determine a definite program of future expansion in a minimum time at a minimum expense, it is stated.

Corrosion Troubles of Oil Industry

Corrosion troubles of the oil industry are likely to increase, L. W. Vollmer and Blaine B. Wescott of the Gulf Research and Development Company, Pittsburgh, Pennsylvania, declare in a symposium of the American Chemical Society on new metals and alloys applicable to the chemical industry. Present conditions, it is pointed out, will be intensified by the existence of large sour crude reserves. New steels are being developed to combat the menace.

"Probably no other single industry is faced with the widely variant and extensive corrosion problems normal to the various phases of the oil industry, the damage from which totals many millions of dollars annually," according to the chemists.

"The drilling for and production of crude oil too frequently entail severe damage to drilling and pumping equipment by the action of the complicated phenomenon, corrosion fatigue. Pipe lines for transportation of oil suffer external attack from corrosive soils and internal perforation through the combined action of sour crude oil containing hydrogen sulphide and the small amount of brine that inevitably accumulates along the bottoms of the lines. The life of lease and storage tanks in the sour crude areas is often counted in weeks and months in sharp contrast with the decades usual in sweet crude areas.

"In the refinery, sour crude oil is equally difficult to handle and necessitates the use of special alloys for heat interchangers, hot oil pumps, still tubes, valves, and other distillation and cracking equipment.

"There is little likelihood of subsidence in the corrosion difficulties of any of the three major branches of the petroleum industry—production, transportation, and refining—for the largest proved crude reserves are known to be sour and their eventual exploitation probably will be attended by an increase in the severity of the present conditions. Solution of the major problems has been slow because of the large tonnage of metal involved, and remedial measures have been confined in most instances to the intermediate alloy steels for obvious economic reasons.

"It is hoped that the steady progress being made in the development of new steels for all branches of the oil industry will continue unabated."

Publish New Rosters of A.P.I. Committees

Revised printed rosters of the membership of American Petroleum Institute Committee No. 9 on the standardization of wire rope and manila cordage and of Committee No. 4 on the standardization of standard rigs and derricks have been published.

The roster of Committee No. 9, which replaces that dated June, 1933, indicates that the Manila Cordage Manufacturers Sub-committee has been reorganized under the chairmanship of J. S. McDaniel, secretary of the Cordage Institute, New York, New York. The roster includes the new interpretation committee under the chairmanship of C. C. Scharpenberg, of Standard Oil Company of California, San Francisco, California.

Changes in the roster of Committee No. 4 reveal that C. A. Dunlop, of Humble Oil and Refining Company, Houston, Texas, has succeeded Hu M. Harris as national secretary, and as chairman of the Engineers' Sub-committee and Southwestern District Sub-committee. C. R. Athy, of International Derrick and Equipment Company, Columbus, Ohio, has succeeded R. R. Bloss as chairman of the Steel Derrick Manufacturers' Sub-committee.

L. L. Aubert Named Chairman Pacific Coast District A.P.I.

L. L. Aubert, of Bankline Oil Company, Los Angeles, California, has been appointed chairman of the Pacific Coast District of the American Petroleum Institute's Division of Production to succeed the late Roy Silent. The appointment was made by W. H. Meier, chairman of the central committee on district activities, with the approval of W. L. McLaine, chairman of the Pacific Coast District Advisory Committee.

Silent, long active in Institute work, died November 11 at Los Angeles. He was elected chairman in April, 1936, and also was chairman of the California District Sub-committee on the Standardization of Standard Rigs and Derricks, a position he had held since April, 1934. He presented a number of constructive papers before the Institute's national and district meetings.

Aubert, who will serve out Silent's term, which terminates at the next spring meeting of the district chapter, formerly was vice-chairman of the Los Angeles Basin Chapter. Other Pacific Coast District officers are:

Vice-chairman for Coastal District, W. L. Bagby, Shell Oil Company, Ventura, California; vice-chairman for San Joaquin Valley, Lloyd Williamson, California Star Oil Company, Fellows, California; treasurer, W. G. Corey, Pacific Gear and Tool Works, Los Angeles, and secretary, D. S. Kilgour, California Oil and Gas Association, Los Angeles.

Safety High in Oil Industry

A man engaged in drilling oil wells can work nine and one-half years before meeting with an accident causing him to lose time, according to the safety records of the American Petroleum Institute for 1935.

In the operating departments of oil companies there was only one lost-time accident every 22 years; in the natural gasoline departments one lost-time accident every 33 years, and in pipe line divisions only one lost-time accident every 38 years.

Jarecki Opens Rodessa Store

The Jarecki Manufacturing Company has opened a new store at Rodessa, Louisiana. D. B. Curry is manager and field salesman, and Paul Carpenter and J. E. Chism store men. The company's full line of oil field equipment is being carried.

THIS LABEL CUTS REPAIRS 75%

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
THE RIDGE TOOL CO. ELYRIA, O.
TRADE RIDGID MARK PAT. PEND'G 14

That guarantee tells the whole story of the amazing strength of RIDGID Pipe Wrenches. It explains why RIDGIDs cut your wrench repairs fully 75%.

Chrome molybdenum nickel alloy jaws—yes, and alloy handles also. Pass U. S. Government and Navy tests—yes. We say RIDGID Wrenches are ALL HEAVY DUTY—and say it with a plain guarantee.

You'll like the no-lock jaws, heel jaw replaceable, hook jaw with handy pipe scale on it; adjusting nut that spins easily in all sizes, 6" to 60", and other features.

At Your Supply Store

THE RIDGE TOOL CO., Elyria, Ohio

RIDGID PIPE TOOLS

REG U. S. PAT. OFF.

B-M-W Admore

Insert Pump Anchor

PATENT NO. 2,027,783

No Working Barrels
No Seating Nipples
No Mechanical Shoes
No Pulling of Tubing

Packs off and holds down directly in the tubing itself. Saves on sucker rods and other equipment where fluid level is high and well can be pumped above bottom. Complete data on request.

Principal B-M-W Products are obtainable at supply stores, including: ADMORE Insert Pump Anchors; NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); BALLS and SEATS (made for every pumping service); ADMORE Liner Barrels; TEX TYPE Plunger Fittings and Valves; and COLLINS Belt Clamps.

BRADFORD MOTOR WORKS INC.

OIL WELL SUPPLIES

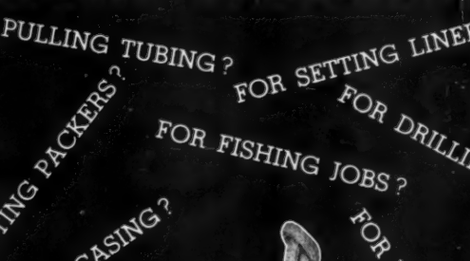
BRADFORD, PA. — TULSA, OKLA.

EXPORT OFFICE, 50 CHURCH ST., NEW YORK CITY

Need a

WEIGHT INDICATOR

FOR PULLING TUBING?
FOR SETTING LINERS?
FOR SETTING PACKERS?
FOR DRILLING?
FOR FISHING JOBS?
FOR SETTING CASING?
FOR PULLING RODS?



MEET THE Clipper

THE INSTRUMENT OF LABORATORY ACCURACY AND OILFIELD RUGGEDNESS

The "Clipper" is the latest advancement in weight indicator design made to meet the ever-increasing demands of modern drilling for accuracy, strength, sensitivity and flexibility. It insures greater accuracy in all oil field operations. Pressure is transmitted by a closed fluid column that eliminates errors that might arise from friction and metal fatigue. The full weight on the indicator is read directly in pounds or in points, regardless of the size of the load, from spudding in to pulling tubing.

Truly the finest and most accurate Weight Indicator yet offered to the oil industry . . . it is a triumph in precision and ruggedness.

The "Clipper" is enclosed in a watertight, streamlined Aluminum case . . . Light weight, compact, self-contained, it occupies less than a square foot of space.

THE WEIGHT INDICATOR
MARTIN DECKER CORP.
LONG BEACH CALIFORNIA

San Joaquin Valley: A. F. McQUISTON, Bakersfield, California
Mid-Continent Distributor: REED ROLLER BIT COMPANY, Houston, Texas

Pat Weems Promoted

The multitude of friends of Pat Weems of Tulsa will be interested in the announcement of his appointment as vice-president and manager of the Tubular Department of the Producers Pipe and Supply Company of Tulsa, Oklahoma.

PAT WEEMS

For the past 12 years Pat has been associated with the International Supply Company. Eight of these 12 years he has been in charge of the pipe department. He is probably one of the best known distributor representatives in the Mid-Continent fields.

Return From Trip to Europe

A. G. Haglund and D. H. Barnwell, of the Axelson Manufacturing Company, returned to the United States the latter part of November after a brief business trip to Europe. Messrs. Haglund and Barnwell flew from Los Angeles to New York, boarded the dirigible Hindenburg for Germany, returned to London, to The Hague, flew to Roumania, back to Sweden, and returned to Los Angeles all in a period of approximately four weeks' time.

In Roumania some time was spent with Axelson's new factory representative, Norbert Winter. Winter, who is well known in Roumanian and Polish oil fields, is making his headquarters at Bucharest. His work involves both sales and service on all products sold by the Axelson Manufacturing Company in foreign areas.

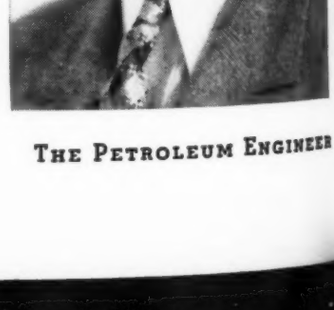
The Venezuelan representative of Axelson for many years, C. C. McDermond, has returned to Maracaibo, after spending two months in Los Angeles at the Axelson factory, two months in the Mid-Continent fields, and a month on the Atlantic Seaboard.

A. E. Bradshaw to Association Executive Committee

A. E. Bradshaw, president, National Bank of Tulsa, has been appointed a member of the executive committee of the Kansas and Oklahoma division of the Mid-Continent Oil and Gas Association.

John A. Chapman Director Equipment Suppliers Association

At the recent meeting of the members of the American Petroleum Equipment Suppliers Association in Chicago, all directors were reëlected except F. E. Bernsen, president of the Lucey Products Corporation, who resigned. This vacancy was filled by the appointment of John A. Chapman, assistant general manager of the Lucey Products Corporation.



JOHN A. CHAPMAN

Formal Opening of Houston Branch Taubman Supply Corporation

HERMAN P. TAUBMAN

Some 2000 to 2500 members of the oil and affiliated industries attended the formal opening of the new Taubman Supply Corporation plant at Houston, Texas, on December 12. From noon until 9 o'clock at night a steady stream of well-wishers to Herman P. Taubman, President, and his staff, enjoyed what was proclaimed one of the most elaborate and efficiently conducted affairs of its kind ever held on the Gulf Coast.

The Houston office and pipe yards are the largest branch of the Taubman Supply Corporation, distributors of casing, tubing, drill pipe, line pipe, and other oil well equipment. Headquarters are in Tulsa, Oklahoma.

Built at the cost of $125,000, on Clinton Drive at Sixty-ninth Street, the complete Houston layout covers 5½ acres of ground, with an auxiliary yard occupying 2½ acres. It will serve the Gulf Coast of Texas and Louisiana, as well as the New Mexico fields. A greater portion of the industry's requirements will be supplied out of this plant, according to Mr. Taubman.

The office building, constructed of brick and situated at the entrance to the grounds, is air-conditioned. In a large display room are arranged many of the products distributed by the Taubman organization.

This plant and yards were pronounced by the visitors to be the largest, most modern, and best equipped of its kind serving the oil and gas industry.

The grounds are prepared for all-weather truck travel and are equipped with floodlights to give day and night service. They are drained by a wood-lined trench system.

Entertainment facilities and good eats were well arranged in typical Taubman style.

In addition to the various members of the Taubman organization who attended the opening, officials from Bethlehem Steel Corporation, Republic Steel Corporation of Cleveland, Ohio; Pittsburgh Steel Co., Pittsburgh; representatives of the National Bank of Tulsa, First National Bank of Dallas, and First National Bank of Houston, and many other personal friends of Herman Taubman were present.

Charles F. Roeser Again Heads I. P. A. A.

Charles F. Roeser of Fort Worth was re-elected president of the Independent Petroleum Association of America at an executive committee meeting that closed the annual convention.

All other officers also were re-elected. They are Harold B. Fell of Tulsa, Oklahoma, executive vice-president; Russell B. Brown, Washington, D. C., general counsel; T. J. Steuart of Washington, D. C., assistant to the president; C. E. Buchner of Tulsa, executive manager, and N. T. Gilbert of Tulsa, treasurer.

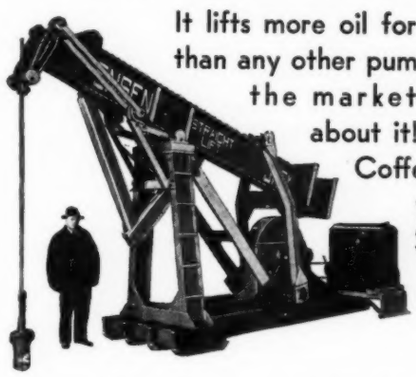
Ask these questions about the
BALLS AND SEATS *you buy!*

1. ARE THEY SURE TO BE TIGHT?
2. ARE THEY OF THE CORRECT HARDNESS?
3. WILL THEY GIVE ME LONG SERVICE?
4. WILL THEY MEET MY REQUIREMENTS?

Hough Specialized Balls and Seats check on every point! They're guaranteed tight; vacuum-tested; made from highest-grade metals; heat-treated in controlled furnaces. Seven specialized types—"Steelex,""Repelex,""Bronzex," "Resistex," "Combinex," "Utilex," and "Kamonex." In stock at your oil-field distributor's.

THE CHARLES N. HOUGH MFG. COMPANY
Franklin, Pa. *Tulsa, Okla.*

It's a JENSEN!



It lifts more oil for less money than any other pumping unit on the market. Find out about it! Wire us at Coffeyville or see your JENSEN dealer.

INCORPORATING 18 YEARS OF EXPERIENCE!

JENSEN BROTHERS MANUFACTURING COMPANY
Coffeyville, Kansas, U. S. A.

CLEAN FLOORS
the easy, quick, low-cost OAKITE WAY

If you want to wash floors so they are really clean, free from slippery films or oily, greasy fire hazardous deposits, clean your floors the Oakite way. Energetic in action, Oakite materials clean thoroughly . . . without the need for laborious brushing or scraping.

GOOD FOR BARREL HOUSES, DOCKS, BULK PLANTS, PUMPING STATIONS

Only small quantities of Oakite materials are needed for washing down pumps, walls, machinery, for reclaiming waste, and all general maintenance. Water soluble, solution strength of Oakite materials is easily varied to meet individual job. Write for free helpful booklet.

Manufactured only by
OAKITE PRODUCTS, INC., 48 Thames St., NEW YORK, N. Y.
Branch Offices and Representatives in All Principal Cities of the U. S.

OAKITE
TRADE MARK REG U.S. PAT OFF.
SPECIALIZED INDUSTRIAL CLEANING MATERIALS & METHODS

The most copied pump in America —Pomona. Why? Because at the outset, Pomona engineers started on bedrock with a fundamentally correct design. They believed they were right . . built pumps . . and owners proved they were right. Owners talked about the dependability and economy of Pomona Pumps. The reputation spread—all over the world. New facories had to be built to handle orders. An announcement of the opening of a complete new eastern plant will be made next month.

Every Pomona Pump sold helps to sell others. So today, Pomona Pumps are made in the largest turbine pump plant in the world by skilled artisans with long training.

The original policy of the Pomona Pump Company is still effective—to make pumps that will lift the most water at the least overall cost and keep on doing it dependably for the longest time. Beyond that, to insure performance by maintaining an international service organization to render prompt help — anywhere — whenever needed, from any cause.

WHY BUY AN IMITATION?

POMONA PUMP CO.
53 W. Jackson Blvd., Chicago • 206 E. Commercial St., Pomona, Cal.
POMONA TURBINE PUMPS

TRADE LITERATURE

THE OILWELL SUPPLY COMPANY, Dallas, Texas, has issued two new bulletins. Bulletin No. 163 is descriptive of the "Oilwell" No. 200 crown block. Contained in the publication are two shop views of the equipment, an outline of advantages and outstanding features, description of construction, instructions for erecting the block, a list of specifications, reeving diagram, assembly drawing, and price list. In addition, an illustration and brief description of the 66-in. streamline traveling block (the companion unit to the No. 200 crown block) are included.

Bulletin No. 165 describes the renewable rubber bushings for guiding "Oilwell" slush pump fluid valves. This single-page bulletin includes a cross-sectional drawing complete with part names and a brief paragraph covering the application of the bushings.

THE CHAPLIN-FULTON MANUFACTURING COMPANY, 28-40 Penn Avenue, Pittsburgh, Pennsylvania, has issued Bulletin No. 2449 descriptive of the Fulton Duplex Sensitive Vacuum or Back-Pressure Regulator. Copies of the publication will be sent free upon request.

THE COOPER-BESSEMER CORPORATION, Mt. Vernon, Ohio, has just released a bulletin describing their Type-GN Diesel. This new engine, one of the popular "N-Line" Diesels, is built in three, four, six, and eight cylinders, rated 50 to 58 hp. per cylinder. Chief among the engine's many modern features as claimed by the makers are quick starting and pick-up, less attention and adjustment required, minimum fuel and lube-oil consumption, and less need for repairs and replacements. Special attention is given to the new atmospheric-relief constant-pressure fuel-injection system.

THE BROWN INSTRUMENT COMPANY, Philadelphia, Pennsylvania, has published a new broadside entitled: "Here's the Answer to Your Temperature Problem," featuring Brown Thermometer Controllers. This bulletin graphically describes the accuracy, simplicity, and ruggedness of Brown thermometer controllers. It also presents a complete description of Con-Tac-Tor mercury switches.

M. O. JOHNSTON OILFIELD SERVICE CORPORATION, Los Angeles, California, has issued a comprehensive treatise that recommends practices, describes the various types of testing, gives detailed information on uses, and operation of testing tools, etc. Copies are available from the manufacturer.

ALLIS-CHALMERS MANUFACTURING COMPANY, Milwaukee, Wisconsin, is releasing another attractive steam turbine bulletin, No. 1181, covering their standard line of high-pressure, non-condensing steam turbine units of the three-valve reaction type suitable for top turbine service, or supplying steam for high-pressure process work. The construction of these turbines is given in considerable detail, including photographs and drawings. One section of the bulletin is devoted to the detail construction of a-c. generators suitable for this type of steam turbine.

THE BRADFORD MOTOR WORKS, Bradford, Pennsylvania, have issued a new catalog sheet pertaining to their B-M-W Admore Insert Pump Anchor. This device, Patent No. 2,027,783, possesses a number of exclusive and valuable features that are fully explained in the sheet. Copies will be mailed upon request.

Trade Personals

E. J. "Jack" DALY, who for 12 years was in Burma with the Burmah Oil Company, returning to the United States last year, is now a member of the sales staff of the Regan Forge and Engineering Company. At present he is making his headquarters at Houston, Texas.

REED O'NEIL has been appointed California district manager by the Reed Roller Bit Company of Houston, Texas. He succeeds **DR. J. V. PENNINGTON,** who has been promoted by the company and transferred to Houston. O'Neil has been with the Reed Roller Bit Company since 1923, and has been connected with the California branch since 1926.

THOMAS L. KIRK, until a year ago assistant general sales manager of Spang-Chalfant and Company, at which time he retired, died recently at Oakmont, Pennsylvania, from a blood-stream infection. He was born in Scotland 60 years ago. Surviving him are his widow, Mrs. Mildred C. Kirk; a brother, Archibald Kirk, of Beaver Falls, Pennsylvania; and two sisters, Mrs. W. C. Clark of Charleroi, and Mrs. David Morrison of Mt. Lebanon.

LELAND D. O'CONNELL, who has centered much of his active business career in the Southwest, has been appointed manager of their Denver, Colorado, office, according to an announcement from the Westinghouse Electric and Manufacturing Company. **WM. TRUDGIAN,** former manager of the office, has been promoted to the post of special representative and will care for the duties previously handled by **L. M. CARGO,** who has retired.

T. N. ST. HILL, vice-president of the Petroleum Rectifying Company, Los Angeles, California, attended the A.P.I. meeting in Chicago, later visiting several of the central states, calling on oil companies and inspecting a number of Petreco de-salting plants, before returning to his headquarters.

H. R. CARPENTER, sales manager for the Jarecki Manufacturing Company, Bartlesville, Oklahoma, has returned to his duties following a recent illness.

GEORGE COLLOM, widely known throughout the South Texas territory from previous field experience in that section, has become a member of the sales staff of Thornhill-Craver Company, Houston, manufacturers of Unibolt couplings. He is making headquarters at Corpus Christi.

GEORGE COLLOM

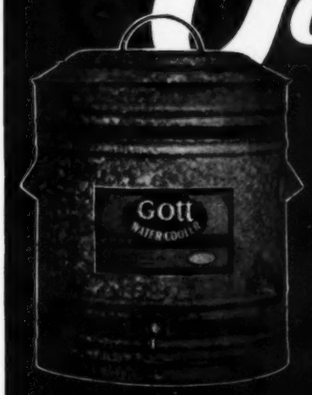
CHARLES HALM

Reda Pump Company Opens Tyler Office

Reda Pump Company, manufacturers of the Reda electrical centrifugal oil well pump, has opened a sales office at 207 East Front, Tyler, Texas. Charles Halm has been assigned to take charge of the new office.

Gotkool

WATER CANS & COOLERS



GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!

GOTT WATER COOLER
Made in 3, 5, 8, 10, and 20 gallon sizes.

GOTT WATER CAN
Made in 1-, 2, 3, 5, and 10 gallon sizes.

H. P. GOTT MFG. CO.
WINFIELD, KANSAS

KEEP PURE DRINKING WATER ALWAYS HANDY

Look for the Leaden Seal on Each Chain

ARMSTRONG BROS.

TESTED CHAINS... 3,600 to 4,000 pounds

These are Tongs of known strength with chains proof-tested to two-thirds catalog rating; with jaws drop-forged from special steel, hardened, tempered *and tested for wearing qualities.*

Handles are forged; the bolt is hardened steel; the shackle drop-forged from chrome-nickel steel. Design improvements give greater bearing on bar, provide guides for chains that prevent jamming.

Standardize on these stronger, handier tongs.

This Seal marks a proof-tested Chain.

Write for Pipe Tool Catalog, just out.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
331 N. Francisco Ave., Chicago, U.S.A.

● HYDRAUGER ●

MODERN HORIZONTAL BORING MACHINE

For Underground Installation of Pipe and Conduits. Avoids damage to costly pavements and saves time. Send for Bulletin.

HYDRAUGER CORPORATION, Ltd.
116 New Montgomery St. • San Francisco, Calif.

SPERRY-SUN WELL SURVEYING CO.

1608 WALNUT STREET, PHILADELPHIA, PA.

HOUSTON, TEXAS. TULSA, OKLAHOMA
AND LONG BEACH, CALIFORNIA

SURWEL (Gyroscopic) H-K (Open Hole) SYFO (Ink Bottle)

UNDERGROUND WELL SURVEYING SERVICE

Mail Your Subscription Now

AGENCY	Established
LONG BEACH	1929
TAFT	1931
OKLAHOMA CITY	1931
BAKERSFIELD	1933
HOUSTON	1933
KILGORE	1933
WICHITA	1934
LYONS	1934
PAMPA	1935
ODESSA	1935
LAKE CHARLES	1936
VENTURA	1936

The above is a list of Cavins branches and agencies, and the year each was established; showing the rapidly increasing use of Cavins Bailers throughout domestic oil fields.

Operators who know, demand the CAVINS AUTOMATIC HYDRAULIC SUCTION BAILER—it gets results.

THE CAVINS COMPANY

2853-73 Cherry Avenue. Phone 414-14; 414-60
Long Beach, California
Cable Address: "Cavins, Long Beach"
Foreign Representative: R. J. Eiche
Bakersfield, Calif.; Taft, Calif.; Ventura, Calif.; Odessa, Texas; Houston, Texas; Kilgore, Texas; Pampa, Texas; Oklahoma City, Okla.; Wichita, Kansas; Lyons, Kansas; Lake Charles, Louisiana.

Index to Advertisers

A

Abercrombie, J. S., Co. 87
Abercrombie Pump Co. 113
American Cable Co. Inside Back Cover
American Hammered Piston Ring Co. 51
American Iron & Machine Works Co.
American Meter Co.
American Roller Bearing Company 9
American Steel & Wire Co.
Anderson, Alexander, Inc.
Armstrong Bros. Tool Co. 119
Axelson Mfg. Co., Ltd. 22

B

Baash Ross Tool Co.
Baker Oil Tools, Inc. 101
Baroid Sales Co. 15
Bartlett Hayward Co. 2
Black, Sivalls & Bryson, Inc.
Bradford Motor Works 115
Bridgeport Machine Company, The 47
Broderick & Bascom Rope Co.
Brown Instrument Co.
Buckeye Traction Ditcher Co. 114
Byron Jackson Co. 85

C

Cameron Iron Works, Inc.
Carbondale Machine Corp.
Cavins Co., The 120
Chaplin-Fulton Mfg. Co., The 114
Chapman Valve Mfg. Co., The 63
Chemical Process Corp. 55
Chiksan Oil Tool Co., Ltd.
Clark Bros. Co.
Continental Supply Co., The 4
Cook, C. Lee, Mfg. Co. 111
Cooper-Bessemer Corp., The

E

Eagle-Picher Lead Co., The 3
Eastman Oil Well Survey Co.
Edwards, E. H. Company
Elliott Core Drilling Co. 97
Emsco Derrick & Equipment Co.

F

Fluid Packed Pump Co. 112
Fluor Corporation, Ltd.
Frick-Reid Supply Corp. 71

G

Gaso Pump & Burner Mfg. Co. 67
General Electric Co. 59
Globe Oil Tools Company 45
Gott, H. P., Mfg. Co. 119
Guiberson Corporation 95

H

Halliburton Oil Well Cementing Company Back Cover
Hazard Wire Rope Co. Inside Back Cover
Hercules Tool Co.
Hinderliter Tool Co.
Hough, Chas. N., Mfg. Co. 117
Hyatt Roller Bearing Co.
Hydrauger Corporation, Ltd. 119
Hydril Company 83

I

International Derrick & Equipment Company
International Harvester Company of America 43

J

Jensen Bros. Mfg. Co. 117
Johnston, M. O., Oil Field Service Corporation 80
Jones & Laughlin Steel Corp.

K

Kobe, Inc. 89

L

Lane-Wells Co.
Leschen, A., & Sons Rope Co. 77
Linde Air Products Co., The 6
Link-Belt Company 56-57
Lone Star Cement Corp.
Lucey Products Corp. 17
Lufkin Foundry & Machine Co. 41

M

MacClatchie Mfg. Co. 105
Martin-Decker Corporation 116
Mason-Neilan Regulator Co.
Mepham, Geo. S. & Co.
Merco Nordstrom Valve Co. Front Cover
Metric Metal Works
Miller Sand Pump Co. 109
Mission Mfg. Co.
Moore, Lee C. & Co. 39

N

National Bank of Tulsa 107
National Supply Companies, The 61
National Tube Co. 13

O

Oakite Products, Inc. 118
Oil Center Tool Co. 75
Oil Well Supply Co. 49
Oil-World Exposition
Otis Pressure Control, Inc.
Oxweld Acetylene Co. 56-57

P

Parkersburg Rig & Reel Co. 99
Patterson-Ballagh Corporation 52
Petroleum Electric Power Club 108
Petroleum Rectifying Co. 79
Pittsburgh Equitable Meter Co. Front Cover
Pomona Pump Co. 118
Prest-O-Lite Company, Inc., The 56-57

R

Rector Well Equipment Co.
Reed Roller Bit Co. 24
Republic Steel Corporation 21
Ridge Tool Co. 115
Rieber Laboratories 93

S

Security Engineering Co.
Shaffer Tool Works 1
Smith, A. O., Corp. 72-73
Smith, E. M., Co. 106
South Chester Tube Co. 25
Sperry-Sun Well Surveying Co. 119
Staynew Filter Corp.

T

Taubman Supply Corp. 64A, 64B and 64C
Titusville Iron Works Co.
Tretolite Company Inside Front Cover
Trimont Manufacturing Co.
Trinity Portland Cement Co.

U

Union Carbide & Carbon Corp. 56-57
Union Carbide Sales Co. 56-57
Union Wire Rope Corporation
U. S. Steel Corporation Subsidiaries 13, 20 and 49
Universal Atlas Cement Co. 20

V

Vernon Tool Co., Ltd.

W

Waukesha Motor Co. 104
Williamsport Wire Rope Co. 19
Worthington Pump & Machinery Corp.

Y

Youngstown Sheet & Tube Co. 18